Back from Iraq: *A Hero's Story*

Popular Mechanics

TECHNOLOGY SCIENCE AUTOMOTIVE HOME OUTDOORS

WISH LIST

The Year's 30 Best WHEELS, GADGETS, TOOLS & TOYS

#1
A Custom Chopper by Jesse James

X Prize Flight
How SpaceShipOne *Really* Did It

Volcanoes
Six More to Worry About

12
0 75470 08638 0
$3.50 US $4.95 CANADA/FOREIGN
DECEMBER 2004

Do It Right: Car Maintenance
Home Improvement Projects
Handling Digital Photos

U.S.-manufactured Nissans consist of domestic and globally sourced parts.
Call 800-NISSAN3. Properly secure all cargo. Factory Spray-In Bedliner and adjustable Utili-track are optional. Nissan, the Nissan Brand Symbol, "SHIFT_" tagline and Nissan model names are Nissan

trademarks. Tread Lightly!® Please. Always wear your seat belt, and please don't drink and drive. ©2003 Nissan North America, Inc.

This One
XRB3-ZXJ-S343

0-178 MPH in 7.9 sec.[1] On street tires.

Call 1-800-525-0613 for a 2'(H)x3'(W) poster of this vehicle. $7.50 U.S. includes postage/handling.

g-Force T/A® Drag Radials
World-record performance[2]

g-Force T/A® KDW
Outstanding Dry and Wet Traction

g-Force T/A® KD
Outstanding Dry Traction

Put your right foot down. Watch the front end rise. Feel your jaw drop deeper and deeper into your chest. The amazing performance of BFGoodrich® tires. Original

1- Gutridge made a pass at 7.98 seconds on January 25, 2004 at a track in Bradenton, Florida, but because this was not set during a race, it is not an official world record.

Copyrighted material

g-Force™ tires: the world's fastest street radials

BFGoodrich® g-Force® tires hold the domestic and import street radial drag racing world records.[2]

©2004 MNA, Inc.

equipment on the 2005 Mustang. And the perfect choice for upsizing (2005 Mustang GT shown on 20" g-Force tires). BFGoodrich g-Force tires. The world's fastest street radials.

2- Domestic: Dwayne "Big Daddy" Gutridge 8.05 @ 181 MPH on 11/23/03.
Import: Paul Etanbi 8.25 @ 170.9 MPH on 10/05/03.

BFGoodrich Tires

TAKE CONTROL

www.bfgoodrichtires.com/g-Force

Copyright ©Mundial

DECEMBER

PM December 2004 Volume 181 No. 12

FLIGHT RISK: Aerobatic racer Kirby Chambliss at the Reno air show. **80**

FEATURES

65 Wish List '05

You want? We got. It's our annual guide to great gear—the perfect hammer, sleekest cellphone, coolest supercar and 27 other top picks.

80 Flying On The Knife-Edge

Cruising an obstacle course at 225 mph, 10 ft. off the deck? It must be aerobatic air racing.

86 Grime Scene

Fingering leaky suspects with garage-floor forensics.

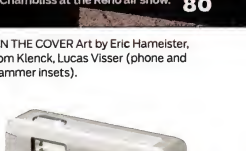
88 Courage After Fire

Guardsman Kevin Pannell's future was shattered by an Iraqi insurgent's grenade. Now this young hero begins his next epic battle: learning to walk all over again.

94 How It Works: The Drivetrain

Front-wheel, rear-wheel, all-wheel drive: the latest innovations, what they really mean—and how to find the right configuration for you.

ON THE COVER Art by Eric Hameister, Tom Klenck, Lucas Visser (phone and hammer insets).



FAVORITES: Fujifilm's F450 digital camera packs 5.2 megapixels.

Popular Mechanics (ISSN 0032-4558) is published monthly by **Hearst Communications, Inc.**, a unit of the Hearst Corporation, 959 Eighth Avenue, New York, NY 10019, U.S.A. Victor F. Ganzi, President, Chief Executive Officer; George R. Hearst Jr., Chairman; Frank A. Bennack Jr., Vice Chairman; Jodie W. King, Vice President and Secretary; Ronald J. Doerfler, Senior Vice President and Chief Financial Officer; Hearst Magazines Division: CathleenBlack, President; Mark F. Miller, Executive Vice President; George J. Green, Executive Vice President; Raymond J. Petersen, Executive Vice President; John A. Rohan Jr., Vice President and Group Controller. Periodicals postage paid at New York, NY, and additional mailing offices. Canada Post International Publications Mail Product (Canadian Distribution) Sales Agreement No. 40012499. Send returns to Quebecor World, P.O. Box 875, Windsor, ON N9A 6P2, CANADA BN NBR 10231 0943 RT. Registered as second-matter at the Post Office at Mexico D.F., Mexico, June 20, 1950. © 2004 by Hearst Communications, Inc. All rights reserved. Printed in U.S.A. POSTMASTER: Send address changes to Popular Mechanics, P.O. Box 7170, Red Oak, IA 51591. **SUBSCRIPTION SERVICE:** Popular Mechanics will, upon receipt from its reader of a completely new or renewal subscription order, undertake fulfillment of that order so as to provide the first-copy delivery either to the Postal Service or alternate carriers within 4 to 12 weeks. If for some reason this cannot be done, you will be notified promptly of the issue date that will begin your subscription, with a request for any further instructions you may have concerning your order. Please address all such orders to us at Popular Mechanics, P.O. Box 7170, Red Oak, IA 51591. • Should you have any problem with your subscription, please write Joan Harris, Customer Service Department, Popular Mechanics, P.O. Box 7170, Red Oak, IA 51591 or call toll-free 1-800-333-4948. Please enclose your mailing label when writing to us or renewing your subscription. • Subscription prices: United States and possessions, $24.00 for one year; $42.00 for two years. Canada and all other countries add $16.00 for each year. **MAILING LISTS:** From time to time we make our subscriber list available to companies who sell goods and services by mail that we believe would interest our readers. If you would rather not receive such mailings, please send your current mailing label or exact copy to: Popular Mechanics, Mail Preference Service, P.O. Box 7024, Red Oak, IA 51591-0024.

We cannot be responsible for loss of unsolicited queries, manuscripts or photos. For return, they must be accompanied by adequate postage. AS A SERVICE TO READERS, Popular Mechanics publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from information published in this magazine.

PHOTO BY PATRICK FRASER (AIRPLANE)

(Please turn to page 8)

Crown Royal
Crown Royal
Here's to outdoing the neighbors.
It's about quality, not quantity. • Visit crownroyal.com

Slide a "no-brainer" under the tree.

"I have found freedom, my friend. And it comes in the form of The Starter Kit."

"Take this battery and plug it... into this tool or this tool or this tool. Someone really gets it!"

"The granddaddy of all combo packs for my granddaddy!"

This Christmas, Ryobi's One+ System is the common sense way to give power tools. Or get 'em.

In the past, every cordless tool you bought came with batteries, a charger and case. Whether you wanted them or not. That's about as logical as requiring you to buy an extension cord and outlet with every corded tool you own.

Well, hallelujah!

Common Sense has finally arrived. Just in time for Christmas.

The idea's simple. **One** common power source that works with every 18V cordless tool we've ever made... or can imagine making. **Plus** a large and ever-expanding suite of truly useful tools you can mix 'n match to your heart's content. Begin with a **Starter** or **Combo Kit** (batteries and charger included). Then add on as your projects dictate or budget allows.

This year, give the gift that every do-it-yourselfer really craves. Power, flexibility, control, possibilities! And then, pass the mistletoe.

Need a replacement battery?

We've applied a little common sense here too. In the form of a big price reduction. Two batteries for $39.95. Yes, Virginia, there is a Santa Claus.

RYOBI 18v ONE+ SYSTEM

One Power Source ✦ Endless Possibilities™

"Now I've got Christmas, birthdays and everything in-between covered for a long time comin'?"

"If I get one of each for me and just one for all of my friends, that's not greedy, right?"

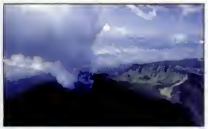
"Dad's battery graveyard of a workbench is no more."

"Lots of tools and just one power source. Merry Christmas indeed!"

"One+ whatever we think of next."

"The one place to get One+."

+more on the way!



THIS MONTH

Mount St. Helens isn't the only volcano brewing up trouble. **PAGE 25**

PM December 2004 Volume 181 No. 12

54

36

148

AUTOMOTIVE

48 Road Trip
Hauling serious cargo with the Ford F-250 Super Duty.

54 New Cars
Breaking news, reports on the latest models and more.

56 Spy Reports
Our global network of agents reveals automakers' secrets.

121 Home Garage
- Car care Q&A
- Saturday Mechanic: diagnosing faulty car heaters.

MONTHLY

14 EDITOR'S NOTES
16 HOW TO REACH US
18 LETTERS
20 TIME MACHINE
148 THIS IS MY JOB

TECHNOLOGY

40 Satellite Radio
XM and Sirius—road-trip tested in the land of bayou blues.

46 Linux Decoded
It's a free alternative to the Windows OS, but is it user friendly?

130 Digital Pix Fix
Organizing and sharing your images has never been easier.

SCIENCE

22 TechWatch
- Secret Navy test chamber.
- Arctic seabed climate cores.
- Broadband's wireless future.

36 X Prize Winner
The backyard engineering behind *SpaceShipOne*.

HOME

100 Comparison Test: 5 Bench Grinders
Which machine hones the winning edge on your tools? Plus: two great sharpeners designed for woodworkers.

107 Skylight Solution
An affordable DIY project to brighten dark hallways without major renovation.

110 Circular Saw Basics
A primer on getting more out of an essential tool.

112 Homeowners Clinic
Answers to your home-improvement questions. Plus: book and product reviews, tip of the month.

PHOTOS BY NATIONAL GEOGRAPHIC IMAGE COLLECTION (MOUNT ST. HELENS); CORBIS (SPACESHIPONE); ERIC BULLER (ERNEST BACHU)

New technology from Bose. Tailored to you and your room.

First it listens.

Then it learns.

Then it adapts.

Introducing the **New Lifestyle® 48** DVD home entertainment system.

It adapts to the acoustics of your room.

Only from Bose. Apart from the quality of your speakers, the greatest impact on the sound you hear is where you put them, and the room itself. With poor room acoustics or less than ideal speaker placement, even a great system can sound like one worth half the price. The Bose® ADAPTiQ® audio calibration system listens to your room, learns where your speakers are, then adapts the sound to overcome most of the acoustical challenges. You no longer need a perfect listening environment for your system to reach its full potential.

ADAPTiQ® Audio Calibration System

It knows what kind of music you like.

uMusic™ Intelligent Playback System

Only from Bose. Our newest advancement is another industry first, the uMusic™ intelligent playback system. First, it lets you store the songs from your entire music collection, up to 350 CDs, right in your Lifestyle® system. But the real breakthrough comes in its unique ability to listen to the music you play and learn your preferences based on your likes, dislikes, or even your mood at the moment. It can then select and play the music you enjoy. Automatically. No menus. No need to create playlists. No computer required.

The Lifestyle® 48 system also includes Bose® link. It allows you to connect other compatible Bose products anywhere in the house. Play different sources in different rooms at the same time, or have instant access to your entire music collection from any room of your home.

Hear the new Lifestyle® 48 DVD home entertainment system. Advanced technology on the inside. Simplicity and elegance outside. With performance we invite you to compare to that of the largest, most expensive systems you can find. Then you'll discover why Bose is the most respected name in sound.

To order directly, or for Bose stores and dealers near you,
call 1-800-ASK-BOSE, Ext. P18
Learn more at ask.bose.com/wp18

BOSE®
Better sound through research®

©2004 Bose Corporation. Patent rights issued and/or pending. The Lifestyle® media center design is also a registered trademark of Bose Corporation. CCM-000479

GIVE US YOUR UNTAMED, YOUR ASSERTIVE,
YOUR LEADFOOTS YEARNING TO BE FREE.
Ford
MUSTANG
Built for the road ahead.

THERE'S A BETTER WAY TO RETIRE YOUR OLD CELL PHONE. RECYCLE IT.
call2recycle
www.call2recycle.org

WHAT'S HOT THIS MONTH ON THE

PM ZONE

@ POPULARMECHANICS.COM

Irresistible.

It's about quality, not quantity
Visit crownroyal.com

CROWN ROYAL ■ IMPORTED IN THE BOTTLE
BLENDED CANADIAN WHISKY
ALCOHOL BY VOLUME (80 PROOF)
©2006 THE CROWN ROYAL COMPANY, STAMFORD, CT

AUTOMOTIVE

AUTOMOTIVE AFTERMARKET INDUSTRY WEEK 2004

SEMA AAPEX AUTOMOTIVE AFTERMARKET INDUSTRY WEEK

There's no way that the small group of high-performance buffs who organized the first SEMA show back in 1967 could have known what it would one day become—a diversified exhibition of nearly 2000 automotive aftermarket companies filling more than 2 million sq. ft. of convention center space. This is a $29 billion industry. Go to **popularmechanics.com/links/sema** for exclusive PM.Zone coverage.

TECHNOLOGY

SHARED CONTENT FROM CRUTCHFIELDADVISOR.COM

CRUTCHFIELD ADVISOR.com The complete A/V information website. CRUTCHFIELD

The PM.Zone is trying something new. From time to time, we'll borrow a select story or two from the audio/video and home electronics editors at CrutchfieldAdvisor.com. This is the A/V consumer-advice companion Web site to crutchfield.com, the well-known electronics e-tailer and mail-order catalog people. Go to **popularmechanics.com/links/scheiner** for our first piece: An interview with legendary recording engineer, Elliot Scheiner, about surround sound audio.

SCIENCE

SPACE TOURISM NOT YET ROUTINE

Yes, Burt Rutan's Scaled Composites *Space Ship One* nabbed the $10 million X-Prize, but why did the craft roll 29 times, 40 miles high? Read **popularmechanics.com/links/x-prize** for our analysis.

HOME

FOR SERIOUS WOODWORKERS

The PM.Zone's Woodworking category ranges from building picture frames to entire furniture suites. With winter setting in, now's the perfect time to pick your favorite project and go to work. Pull up a chair at **popularmechanics.com/links/woodworking**

WIN
A Wrangler® Five Star Racing Adventure In Las Vegas

Wrangler® is pleased to offer one lucky Popular Mechanics reader a trip to Las Vegas for a fast and furious weekend of racing excitement.

Grand Prize includes:
Round-trip airfare and accommodations for two

Two tickets to the biggest Vegas racing event of the year

Two pairs of Wrangler® jeans

To enter, go to www.popularmechanics.com/wrangler/

Wrangler
FIVE STAR Premium Quality DENIM

Real. Comfortable. Jeans.

For a retailer near you, call toll-free 1-877-897-HERO
Or visit www.wrangler.com

One color goes with everything.

Introducing all-new reformulated Prestone® Antifreeze/Coolant.
Good for any make, any model car, and mixes with any color antifreeze.

Trust Prestone®. For your own protection.

A **Honeywell** car care product. www.prestone.com ©2004 Honeywell International, Inc.

Standing Tall

AS a magazine editor, sometimes you encounter a story that humbles you.

Recently, we sent longtime POPULAR MECHANICS contributor Leslie Sabbagh to Walter Reed Army Medical Center in Washington, D.C., to interview soldiers who had been injured in Iraq. She came back with the story of a hero.

His name is Kevin Pannell. Like a lot of soldiers, the Arkansas native wasn't necessarily gung-ho to fight when he signed up for the Army National Guard eight years ago. But a war came, and he was called, and he went. Then, on June 13, 2004, while patrolling a Baghdad neighborhood soldiers call "Little Fallujah," Pannell heard the sound every soldier in urban combat dreads—a grenade rattling across pavement.

It came to rest against his right foot. And then it went off. In previous wars, soldiers often didn't live through such an attack. With improved helmets and body armor and faster evacuation and treatment, men like Pannell are now more likely to survive. But at a steep cost. Despite four operations, the Army surgeons couldn't save Pannell's shattered legs.

Like most severely injured soldiers, Pannell was transported to Walter Reed. Sabbagh, an experienced medical reporter, first met him there in August. "Kevin is tough," she says, "but his generosity of heart constantly shines through." Sabbagh watched as Pannell was fitted with a computerized prosthetic leg—a C-leg—and stood for the first time.

"He has an awesome attitude," says Spc. Harvey Naranjo, an occupational therapist who works with amputees at Walter Reed. "You can't hold him back." Naranjo is another of the heroes in Sabbagh's story. "I wear the uniform too," he says. "At any point it could have been me going through this."

Naranjo takes issue with some press accounts that portray wounded veterans as undereducated victims of policies they don't fully understand. "A lot of people think these guys entered the military because they didn't have other opportunities," he says. "That's not true. They join for love of country."

Pannell is a relentlessly upbeat man with a wicked sense of humor (he signs his e-mails "Stumpy"). But he bristles at any imputation of victimhood. "I'm not a victim of anything," he says. "Nobody put a gun to my head forcing me to enlist." People lose limbs all the time in car accidents, he notes. At least his loss came while doing something he believes in.

"I'm lucky to have met these guys," Naranjo says. "They inspire me." Naranjo works closely with a group called the Wounded Warriors Fund (www.woundedwarriorhospitalfund.org), which supplies patients with basic amenities, and then helps them rejoin society as they recover. PM supports the fund, and we've asked our advertisers to help out as well. Contributions can be sent to: Wounded Warriors, c/o Great Western Bank, Building 147, Offutt Air Force Base, Bellevue, NE 68113.

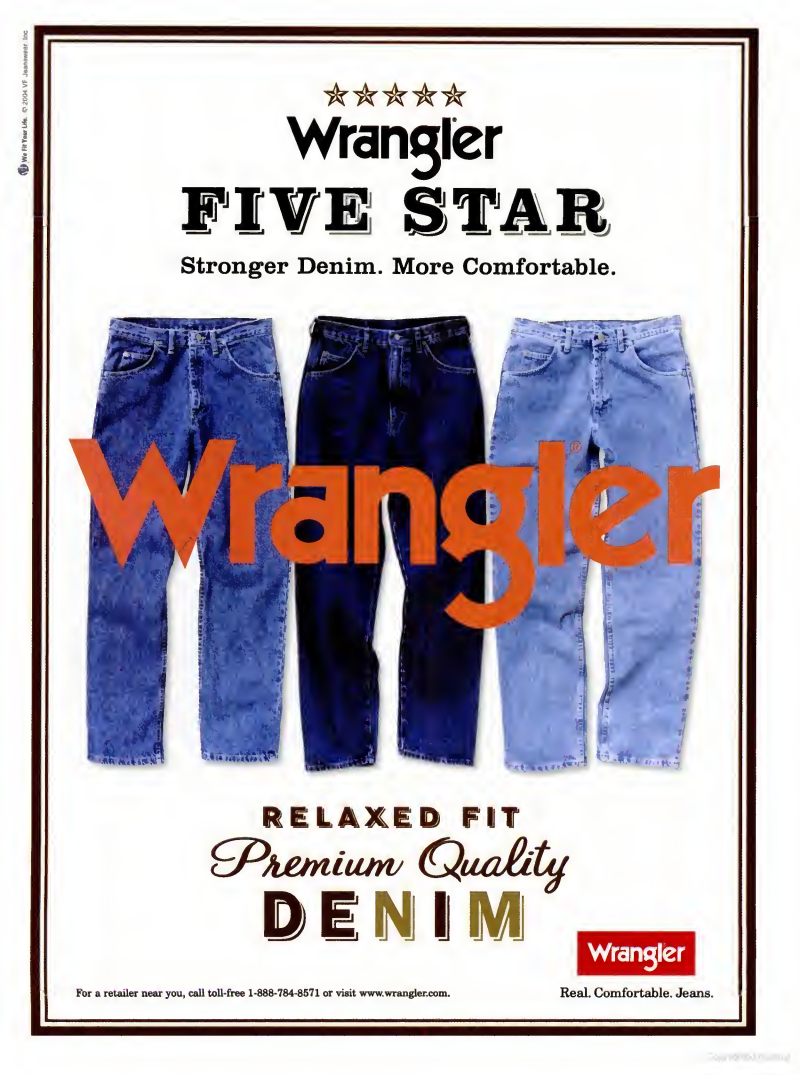
Leslie Sabbagh admits that at one point during her interviews with Pannell, she let her professionalism slip and her feelings show. "I just said, 'Thank you,'" she recalls. "Kevin kind of smiled and nodded. Then he said he was just doing his job." PM

James Meigs

PROUD FATHER: Army Spc. Kevin Pannell with his 3-year-old son, Hunter.

PHOTOS BY ALYSON ALLAMO (JAMES MEIGS), YUNGHI KIM (KEVIN PANNELL)

Wrangler® Five Star Jeans. © 2004 VF Jeanswear, Inc.



Popular Mechanics

James B. Meigs
Editor-In-Chief

David Dunbar
Executive Editor

Jerry Bellinson
Deputy Editor

Sarah Deem
Managing Editor

Michael Lawton
Design Director

HOME
Steven Willson
Editor

Thomas Klenck
Roy Berendsohn
Associate Editors

Norman Becker
Contributing Editor

Lynne Abbate
Editorial Assistant

AUTOMOTIVE
Don Chaikin
Editor

Jim Dunne
Detroit Editor

Mike Allen
Associate Editor

Ben Stewart
West Coast Editor

Jay Leno, Joe Oldham, Jim McCraw
Contributing Editors

Ines Kolanovic
Editorial Assistant

SCIENCE
Fred Mackerodt
Contributing Editor

TECHNOLOGY
Tobey Grumet
Editor

Rebecca Day
Contributing Editor

OUTDOORS
Rich Taylor
James Vlahos
Contributing Editors

Glenn Derene
Associate Editor

Benjamin Chertoff
Researcher

ART
Alan Andresen
Art Director

Patti Gareri
Associate Art Director

PHOTOGRAPHY
Allyson Torrisi
Consulting Editor

PRODUCTION
Kim Sipes
Copy Chief

James Ross
Copy Editor

Greig O'Brien
Production Editor

Anthony Verducci
Production Director

Jatniel Delgado
Production Associate

PM.ZONE
Alain Tschanz
Webmaster

Ken Juran
Online Editor

EDITORIAL ADMINISTRATION
Tracy Saelinger
Asst. To The Editor-In-Chief

Wendy Logroño
Business Associate

EDITORIAL OFFICES
810 Seventh Ave., New York, NY 10019
212/649-2000

SUBSCRIPTIONS
800/333-4948

Bill Congdon
Publisher

Jane Wladar
Associate Publisher

Bruce A. Mitnick
General Manager

Michael S. Ditteiman
Executive Director, Marketing
212/649-2874

RoseMarie Massaro
Marketing Director
212/649-2880

Glen Fuenmayor
Marketing Art Director
212/649-2896

Kim A. Boknoski
Marketing Manager
212/649-2875

Andres Lahoz
Online Marketing Manager
212/649-2878

Andrea Sibilia
Marketing Coordinator
212/649-2898

Rick Day
Circulatian Director

Carole L. Hartman
Production Director

Liliana M. Ruiz
Production Manager
212/649-2877

Karen O'Rourke 212/649-2872
Admin. Advertising Coordinator

Claire Rottino 212/649-2903
Sales Coordinator

ADVERTISING SALES OFFICES

NEW YORK
Jeff A. Timm
212/649-2901
Matt Bondlow
212/649-2902
810 Seventh Ave., 6th Floor,
New York, NY 10019

SAN FRANCISCO
Ted Smith
Manager
415/362-7797, ext 236
Hartle Media
59 Grant St., 4th Floor,
San Francisco, CA 94108

DETROIT
Laurence E. Lantzy
Manager
248/614-6010
Hearst Magazines Sales, Inc.
2301 W. Big Beaver Rd.,
Suite 351, Troy, MI 48084

LOS ANGELES
Dennis Driscoll
Manager
310/364-2921
3000 Ocean Park Blvd.,
Suite 2004
Santa Monica, CA 90405

CHICAGO
Richard T. Welthas
Manager
312/984-5195
Spencer J. Huffman
National Accounts Manager
312/984-5191
1 S. Wacker Dr., Chicago, IL 60606

DALLAS
Daniel F. Kellner
Manager
972/529-9687
D.F. Kellner & Co.
2714 Brookside Ln.,
McKinney, TX 75070

DIRECT RESPONSE ADVERTISING
Jackie O'Connor 212/649-2930
Rene C. Blemer 212/649-2929

CLASSIFIED ADVERTISING REPRESENTATIVE
Manager **Jamie Mejzak** 800/394-5157, ext 48
McNeill Group, Inc.
385 Oxford Valley Rd., Suite 420, Yardley, PA 19067

PUBLISHED BY THE HEARST CORPORATION
Victor F. Ganzi
President & Chief Executive Officer

George R. Hearst Jr.
Chairman

Frank A. Bennack Jr.
Vice Chairman

HEARST MAGAZINES DIVISION
Cathleen Black
President

Mark F. Miller
Executive Vice President

Michael Clinton
Executive Vice President, Chief Marketing Officer & Group Publishing Director

Richard E. Deems
Publishing Consultant

Gilbert C. Maurer
Publishing Consultant

Communicate With Us

We want it to be easy for you to communicate with us.

Here are some ways you can do it.

LETTERS

Your written letters are always welcome. If we think your letter would be interesting to other readers, we might even print it in our Letters column (unless you request that it not be printed). Send your letter to one of our editors, who are listed by department on the masthead on the left. You can send it in any of the following ways:

- **E-MAIL:**
  popularmechanics@hearst.com
- **MAIL:**
  Popular Mechanics
  810 Seventh Ave., 6th Floor
  New York, NY 10019
- **FAX:**
  212-586-5562

SUBSCRIPTION INQUIRIES

Call 800-333-4948 or visit our Customer Care Web site, www.ccare.hearstmags.com.

PM.ZONE

You can log on to the PM.Zone Web site at www.popularmechanics.com. We recommend using Netscape 7 or Internet Explorer 5. Our five channels of content—Automotive, Home, Science, Technology and Outdoors—are designed to keep you entertained and informed all day. The big home page features a fresh bit of science news every day in Technology Watch, a news feed that's updated every 20 minutes, and the Specials column, which promotes upcoming stories, seasonal show coverage and the POPULAR MECHANICS Racing Calendar. Each channel has its own home page, with a feature story and a Specials column. The newest highlight is an auto blog (Web log) that is updated every day.

Another satisfied body part,
brought to you by ThermaCare.

It's the news your knees have been waiting for: ThermaCare is now available in a knee wrap. Eight hours of continual heat relief for reduced knee stiffness. No more cords, no more smelly creams, no more unhappy knees.

Wrap Yourself in Relief.

©2004 P&G thermacare.com

Pocket Rockets

Like it or not, these minibikes are motorized vehicles and should require a license to operate [Gentlemen, Start Your Tiny Engines, Oct.]. Giving one of the $200 Chinese knockoffs to a kid is irresponsible parenting, and puts them on the street with cars, trucks and other traffic.

ALBERT F. KAMMERER
Sacramento, CA

I rode these mini sport bikes 12 years ago in Japan. Why does it take so long for stuff to catch on in the States?

SCOTT SCHESSER
Via Internet

THRILL RIDE: Responsible speed freaks at Stockton Motorplex Park.

MINING THE MOON

Three cheers for Harrison Schmitt's article on mining the moon for helium-3. What will make space habitable is infrastructure. For infrastructure to develop, there first must be a compelling economic reason for substantial numbers of people to venture beyond our planet. In his exciting essay [Mining The Moon, Oct.], Schmitt has given us just such a first cause.

LEE JAMISON
Dodge, TX

Mining the moon? What a laugh. They can't even make a space shuttle that will regularly lift off from Florida, let alone lift off carrying the massive equipment needed to mine the moon.

JAMES THORNTON
Via Internet

If it takes a square mile of lunar surface to power a city the size of Denver for an entire year, how much of the lunar surface will have to be sacrificed to power just half of the United States for 10 years? Are we really willing to turn the moon into a cue ball just to get helium-3?

CARY WOODSON
Mt. Juliet, TN

All the helium-3 in the world wouldn't help us create a viable fusion power plant.

MIKE MASLOWSKY
Via Internet

The government has never had a long-term plan for mining the solar system. Sadly, the longer we wait to develop such a plan to lessen our dependency on foreign oil, the more we endanger our future.

MIKE MARTINEZ
Lakeland, MN

IT WORKED FOR ME

Your suggestion for preventing lock jams using oil applied to a key [It Worked For Us, Oct.] is poor advice. Petroleum-based lubricants attract dust, which builds up and congeals in the lock cylinder, causing the tumblers to stick, and increasing wear. Powdered graphite is a better solution.

PETER P. SCHIFFERLI, LOCKSMITH
Tonawanda, NY

To be considered for publication, please include your full name and address, even if you send via e-mail. We'll withhold both upon request but we will not print any anonymous letters. All letters are subject to editing for length, style and format.

READER PROJECT OF THE MONTH

I built my storage building based on the plans in the March 2004 issue of POPULAR MECHANICS. Your plans were concise, simple and easy for me to follow. My building is 10 x 12 ft., and is set on six 4 x 4 pressure-treated posts planted 18 in. off the ground. The walls and floor are on 16-in. centers. The roof tresses, which are well anchored with hurricane hardware, are on 24-in. centers. A ramp leads to the entry, which is about 14 in. off the ground.

C.B. MIDDLEBROOKS, *Tallahassee, FL*

If your project is chosen as Reader Project Of The Month, you will receive a token of our appreciation for sharing your project with us. For your project to be considered, please send a clear, color photo and brief description to: Reader Project Of The Month, Popular Mechanics, 810 Seventh Ave., 6th Floor, New York, NY 10019.

ILLUSTRATION BY PAUL DIMARE (COVER). PHOTO BY JAMES A. SUGAR (TOP RIGHT)

DURABILITY

ISN'T ALWAYS A PRETTY THING

The Hitachi power tool is crafted of the finest materials available, engineered to specifications unmatched, built with technology not found with any other manufacturer, designed to endure for years. Used by professionals and coveted by the novice...this, is the Hitachi power tool.

www.hitachipowertools.com

10 Amp
Reciprocating Saw
CR13V

12 Volt Impact Driver
w/ LED Job Light
WH12DAF

5/8"
Hammer Drill
FDV16VB2

10" Slide Compound
Miter Saw w/ Laser Guide
C10FSH

HITACHI
Inspire the Next

Available Nationwide at LOWE'S

©2004 by Lowe's®. All rights reserved. Lowe's and the gable design are registered trademarks of LF, LLC.

100 Years Ago (December 1904)

IMPACT RESISTANCE

The field of orthopedics received a minor setback in 1904 when this protective football suit came out. "Padded with felt at all points where protection is needed most," the outfit looks more like a pair of bicycle shorts than body armor, at least when compared to today's football gear. "The pads," PM noted, "have a great advantage over the old style, which had a tendency to move out of place just when they were needed most." Ouch.

75 Years Ago (December 1929)

BEFORE HOWARD STERN

In 1929, PM explained the bells and whistles of the technology behind, well, annoying bells and whistles. Radio announcers used large cabinets housing automated noisemakers such as horns and sand-filled cylinders to imitate footsteps or crowd noises. Due to modern advances, all that has been replaced by the incessant guffawing of professional sidekicks such as Artie Lange.

25 Years Ago (December 1979)

VIRTUAL BANALITY

The era that gave rise to eight-track cassettes and "Saturday Night Fever" also provided this insight: Amusement-park-goers would prefer a lame, Captain EO-type simulation ride to an old-fashioned roller coaster. In fact, the SR2 from Doron Precision Systems was seen as "the end of huge, expensive roller-coaster-type rides." In the years since, lines have dwindled at these "simulation units," while the popularity of roller coasters—bigger, faster and scarier than their predecessors—has continued to climb.

50 Years Ago (December 1954)

COLD COMFORT

Back in 1954, air conditioning in cars was about as standard as DVD players. But luckily for desert road trippers, some gas stations in the Southwest were offering "spot air-conditioning," in which a hose from a 3-ton a/c unit was inserted through the car windows, providing a blast of cold air and improving comfort for, oh, about 10 seconds. PM

NEW IMPROVED
RIGHT GUARD GEL

THE STRONGEST, TOUGHEST GEL OF ALL GELS

New improved Right Guard® Gel is the strongest* gel. It even keeps you drier than the leading stick. Its breakthrough gel formula goes on clear and keeps you dry right to the end of the day.

For long-lasting odor protection, try new Right Guard® Power Caps™ with extra odor fighting capsules.

START RIGHT
END RIGHT

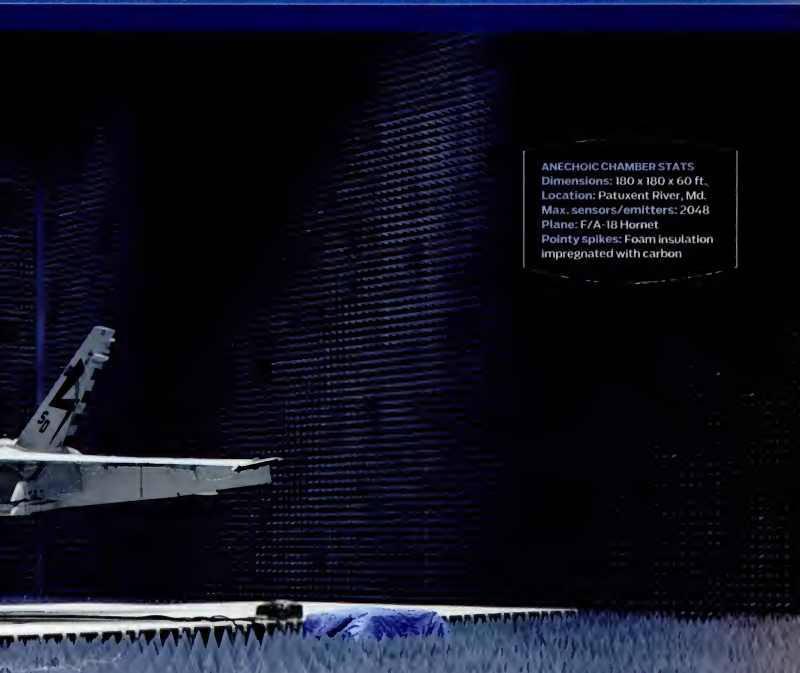
© 2004 The Gillette Company

*strongest against wetness

Copyrighted material

TECHWATCH

AVIATION COMPUTERS DEFENSE ENERGY ENVIRONMENT MEDICINE ROBOTICS SPACE TRANSPORTATION



ANECHOIC CHAMBER STATS
Dimensions: 180 x 180 x 60 ft.
Location: Patuxent River, Md.
Max. sensors/emitters: 2048
Plane: F/A-18 Hornet
Pointy spikes: Foam insulation impregnated with carbon

Chamber Of Secrets

THIS F/A-18 Hornet recently dangled from a 40-ton hoist inside a massive anechoic (without echo) chamber at the Navy's Air Combat Environmental Test and Evaluation Facility in Patuxent River, Md. Built to accommodate planes up to the size of a Boeing 707, this chamber creates an almost perfect electromagnetic barrier between its interior and the outside world. The plane can be networked to a manned flight simulator in another building, so that pilots can test the plane's radar, communications and guidance systems in real time, without fear of outside interference—or enemy snooping. According to Naval Air Systems Command technical adviser Chad Miller, "Virtually every model series [plane] deployed by the Navy today has been through that chamber."

TITAN, Saturn's largest moon, has a dense atmosphere that is unique in the solar system, and the Cassini-Huygens Saturn mission is about to peek beneath the clouds. On the 24th, the Huygens probe will detach from the Cassini orbiter to begin its 21-day descent to the surface. Although it is too cold to expect to find anything growing now, Titan is thought to possess all the chemical prerequisites for life. "We think it's a window to viewing processes in early Earth's history," says Dennis Matson, chief scientist for the project. Recent study of Titan has suggested seas of minus 290°F liquid hydrocarbons, so Huygens's lunar landing may turn into a cold shower.

Daylight Fades

From the U.S. Naval Observatory: The winter solstice will occur at precisely 12:42 (GMT) on Dec. 21 ... St. Louis will receive 9 hours, 28 minutes of daytime ... The average year has 365.2425 days (astronomers use a 400-year cycle to fix the math) ... Earth's spin is slowing by 2 milliseconds per day per century ... In 3 million years there will be an extra minute each day.

More Caviar, Dale?

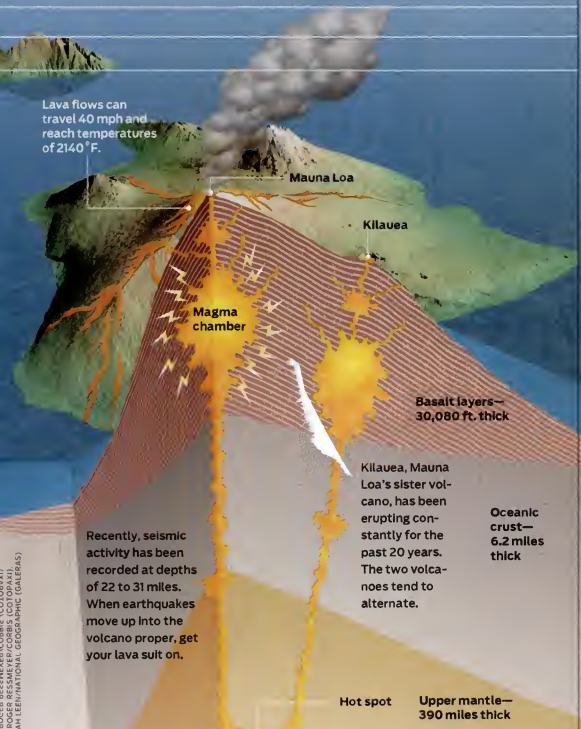
THE third of the month will bring a cultural exchange when Nextel Cup drivers and their crews belly up to the most stiffly starched tablecloths in the land. It's time for NASCAR's annual black-tie awards banquet at New York City's ultrafancy Waldorf-Astoria hotel. Expect driver attendance to be high, as this is when the big-money checks are presented to the winners—last year over $17 million was paid out. No trackside seats here, but you can watch it on the TNT network.

Dec. 14 sees the release of Gran Turismo 4 for Sony PlayStation 2. With more than 650 cars (the most ever available in a video game), you can skid a 19th-century Daimler steam engine through the streets of medieval Italy or go cliff-diving in a new BMW M5 at the Grand Canyon.

Malls: 1 Mouse: 0

LATE this month, the U.S. Fish and Wildlife Service will consider removing the Preble's meadow jumping mouse from the endangered species list. A conservation success story? Not really. It turns out that the Preble's mouse may never have even existed—as a unique species, at least. New DNA evidence suggests that it is a variety of the Bear Lodge Mouse, which is not protected. The upshot? If the Preble's mouse is delisted, sensitive lands on the Rocky Mountain Front Range will lose vital federal protection.

PHOTO COURTESY OF NASA

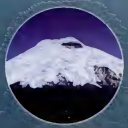


Ready To Blow?

MOUNT St. Helens isn't the only volcano that's come to life recently. After 20 years of silence, Hawaii's Mauna Loa, the most massive bit of geological acne on Earth, has also been stirring. Since July more than 500 quakes have rumbled deep below the volcano's surface. Previous eruptions have been heralded by tremors to the south and west, but the current quakes are happening directly beneath Mauna Loa.

Most volcanologists agree Mauna Loa will erupt before long, but Hawaiian volcanoes are "shield" volcanoes, which means that spectators could pack a lunch and watch. At right are four of the planet's scariest "stratovolcanoes," the very explosive kind capable of turning entire cities into graveyards. —*Glenn Derene*

MOUNT VESUVIUS, ITALY Yes, *that* Mount Vesuvius, the volcano that buried Pompeii in A.D. 79, is rumbling. **WHY WORRY:** One million-plus live in nearby Naples.



COTOPAXI, ECUADOR This 19,388-ft.-high monster is restless—and capped with glaciers. **WHY WORRY:** Volcanic heat can turn glacial ice into muddy rivers (called lahars) with the consistency of wet cement.

MERAPI, JAVA, INDONESIA Indonesia has more volcanoes than any other country, and Merapi is the most active. **WHY WORRY:** Locals consider the peak sacred—and 50,000 of them live on its slopes.

GALERAS, COLOMBIA An eruption from this notorious smokestack in 1993 killed nine people on a scientific expedition. **WHY WORRY:** It has been belching smoke in recent months.

PHOTOS BY JONATHAN BLAIR/CORBIS (MOUNT VESUVIUS); ROGER RESSMEYER/CORBIS (COTOPAXI); GEORGE F. MOBLEY/NATIONAL GEOGRAPHIC (MERAPI); SARAH LEEN/NATIONAL GEOGRAPHIC (GALERAS)

ILLUSTRATION BY ROBERT KEMP

Robo-Prop

SAY hello to the FR-II, a showpiece of miniaturization from Seiko Epson of Japan. This 3.35-in.-tall, 0.43-ounce flying microrobot carries its own battery, two 32-bit RISC microcontrollers, two ultrasonic motors, a digital camera and one of the world's smallest gyrosensors.

The FR-II can follow a flight program sent to it wirelessly from a computer via Bluetooth.

Seiko Epson hopes the tiny robot's ability to swoop into spaces too small for humans will eventually allow microrobots to be used for security and rescue work.

Image Consultants

RESEARCHERS at Caltech and the Doheny Eye Institute at USC are developing a new way to help the blind using a palmtop computer and a camera mounted on sunglasses. Dubbed DORA (Digital Object Recognition Audio), the system identifies objects in the user's path by comparing captured images to a database of common objects. It then proclaims such statements as, "This is a red plate."

Ticker Tech

THE WALLS HAVE EARPLUGS

It turns out that Grandma's floral print isn't the most stifling wallpaper ever made. BAE Systems in England has developed a wall covering that can turn an enclosed space into an electronic "safe room," protecting wireless computer networks from espionage without interfering with cellphone use. This Frequency Selective Surface is similar to the screening technology used on the stealth bomber. A transparent version for windows is under development.

WORD OF THE MONTH

Clutch Pirate *(n.)* **Opportunistic male frog that dupes natural selection by refertilizing the eggs left behind by other mating pairs.**

THE STINK THAT STAYS

The Israeli army has developed a crowd-clearing nonlethal "skunk bomb" with a synthetic, horrible-smelling odor that is modeled on actual skunk spray. The pungent stench is designed to permeate victims' clothing for up to five years. (No word on the brave soul who volunteered for that test period.)

RECORD HOLDERS

Historic musical recordings in danger of fading away forever are being rescued at the Lawrence Berkeley National Laboratory. Using an optical measuring technique usually reserved for studying subatomic particles, researchers scan aging wax and shellac recordings to produce a 3D digital model of the grooves. During the imaging nothing touches the surface of the recordings, allowing researchers to work with fragile materials.

(Please turn to page 28)

PHOTOS BY REUTERS/LANDOV (HELICOPTER), JCONICA/GK AND VIKKI HART (SKUNK)

BEST BUY
Thousands of Possibilities
GET YOURS
SEABISCUIT
PEELE STRIKE
MADDEN 2004
BestBuy.com
© 2004 Best Buy

Ticker Tech

IN-FLIGHT PHONING

Reach out and touch someone—from 40,000 ft. European airplane manufacturer Airbus announced this fall that it had successfully placed a midair cellphone call from an A320 over Toulouse, France. The call was routed through a miniature transceiver called a "picocell" on board the airplane, then bounced off a Globalstar satellite to a ground-based telephone network. Both Airbus and archrival Boeing plan to offer mobile phone service and Internet connectivity on their aircraft by 2006.

360 teraflops

Proposed speed of IBM's BlueGene/L, which will be the world's fastest supercomputer when it is finished next year.

SURE SHOT

Anyone who is on the receiving end of a needle wants the nurse to get it right the first time. UK Haptics has developed a virtual reality training system that promises to help students perfect their venipuncture skills. The system uses a 3D display of a hand and its vein structure, and the PHANTOM, a force-feedback electronic stylus made by SenseAble Technologies of Woburn, Mass. It gives students highly realistic tactile sensations as they attempt to insert a virtual needle into a vein. According to UK Haptics managing director Gary Todd, "The pressure feedback and realism of the experience are so real that it has made some people feel nauseous."

CONTRIBUTORS:
Benjamin Chertoff, Michelle Delio, Mike Fillon, James Ross.

(Please turn to page 30)

Drill Ride

IN late August, some 150 miles from the North Pole, a team of scientists bored into the Lomonosov Ridge, a massive underwater mountain range that once was part of Siberia. The Arctic Coring Expedition required three icebreakers, a crew of 150, two helicopters, $12.5 million and some of the toughest deep-drilling equipment ever made. The team pulled a sediment core 320 meters long from the depths of the Arctic Ocean. Rice University geochemist Jerry Dickens spoke with PM from Tromsø, Norway, the day he returned from a month at sea.

PM: Three icebreakers? Isn't that a bit excessive?
JD: The ice management team had to figure out how to keep these massive floes from ramming the drilling ship, which was a Swedish icebreaker called the *Vidar Viking*. We had helicopters installing GPS buoys on the ice sheets to monitor how fast the ice was coming at us. Then the *Sovetskiy Soyuz*, this very powerful nuclear Russian icebreaker, would break up the largest ice sheets. Another Swedish icebreaker would chase down and block the broken chunks.

PM: The core represents 56 million years of history. What are the highlights?
JD: One of the most interesting layers occurs at 50 million years. It's a very thick, black, laminated section, so we think it's full of organic carbon and fossils, particularly diatoms. In that, we found what we dubbed the Azolla event.

PM: Azolla is the scientific name for duckweed, right?
JD: Yes. And duckweed only grows in fresh water. We saw that and said, wait a sec. At one time, the Arctic was a lake. That was a big thrill.

PM: Any other big advances?
JD: About 55 million years ago there was an event called the Paleocene-Eocene thermal maximum. It was a period when the Earth warmed up very, very fast. We found that event at the bottom of our hole, which means the Arctic opened up 5 [million] to 6 million years earlier than we'd thought. Looking forward, if we think about global warming and fossil fuels, the climate change models predict that the first place we'll see really strong warming is the high Arctic. So now you can go back and say, well, what actually happened during a time of major carbon input and major warming? Once we open up this core, we'll be able to remove some of the guesswork about the future.
—Jill Davis

ICE MACHINE: The *Sovetskiy Soyuz*, driven by twin nuclear reactors, helped the team work at 88 degrees north latitude.

PHOTO BY BRYAN & CHERRY ALEXANDER (ARCTIC PHOTO), GETTY IMAGES (AIRPLANE)

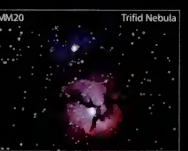
MEADE®

Computerized Telescopes

Starting at $299 at meade.com

Explore Your Universe

Spend the evening taking a space walk with your Meade telescope. Many of those faint, fuzzy dots you see in the night sky are actually distant galaxies, star clusters and nebulas. View or photograph them in all their stunning beauty. All you need is a clear night, a dark sky and a little curiosity. Let your Meade computerized telescope take you on a lifelong journey of discovery and learning.



Take pictures like those shown above.

All four images above were taken with the new Meade *Deep Sky Imager*,™ an easy-to-use astro-camera that allows even a novice stargazer to photograph deep sky objects like a professional. Photograph planets, galaxies, star clusters and nebulas in all their mysterious detail and color. You just install the AutoStar Suite™ software (included) into your PC, plug in the connector cable, and then insert the *Deep Sky Imager*, in place of the telescope's eyepiece. It's that easy. The AutoStar Suite software (included) automatically sorts, combines and aligns the images, giving you stunning astrophotographs that are suitable for framing.

MEADE ELITE DEALERS

ONSIDE PHOTO & TELESCOPE/Oceanside, CA
E38-9638
OPTCORP.COM/MEADE

XCOPES.COM/Duluth, MN
003-5873
TTELESCOPES.COM/MEADE

ASTRONOMICS/Norman, OK
800-356-6603
WWW.ASTRONOMICS.COM/MEADE

WOODLAND HILLS TELESCOPE/CA
877-626-3233
WWW.TELESCOPES.NET/MEADE

ANACORTES TELESCOPE/Anacortes, WA
888-996-3233
WWW.BUYTELESCOPES.COM/MEADE

SHUTAN CAMERA/Vernon Hills, IL
866-621-6363
WWW.SHUTAN.COM/MEADE

MEADE®
A publicly-traded, employee-owned company (NASDAQ symbol: MEAD)
MEADE.COM
800-495-3843

Copyright © 2004 Meade Instruments Corporation. All rights reserved. 30-04076.

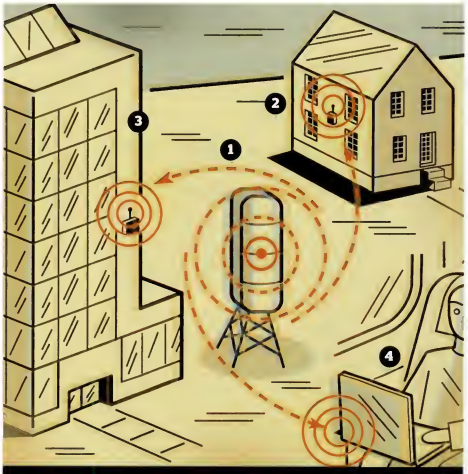
Broadband On The Go

BY GLENN DERENE

IN the world of broadband Internet access, a sweeping change is about to arrive out of thin air—literally. The airwaves will soon begin carrying the signals of WiMAX, a long-range wireless technology poised to blow open the doors to high-speed Internet, changing the rules on who can offer it, who can get it, where they can get it, and how much it will cost.

WiMAX takes a technological flying leap over wireless local area networks (WLANs) such as Wi-Fi (802.11) and personal area networks (PANs) such as Bluetooth, which are designed to offer short-range interconnectivity between computers and peripheral devices. WiMAX is a metropolitan area network (MAN), broadcasting high-speed connections to the Web over distances of up to 30 miles. That means that a fast connection will no longer require fiberoptics, copper cables or sophisticated telephone-line trickery. In fact, WiMAX's potential shines brightest in places that the technological powers have ignored, by jumping over the current "last mile" data pipelines.

The technology will arrive in two waves. The first products, due at the end of 2005, will offer a "fixed wireless" option for homes and small businesses. "WiMAX will initially be used to spread broadband out into rural and emerging areas where cable and DSL can't reach," says Joe English, director of wireless leadership programs at Intel. Rather than laboring for weeks to install expensive landlines, technicians could bring broadband to a new neighborhood by simply attaching an antenna to an existing cellphone tower. Eventually, WiMAX could open the broadband market to dozens of new players. "As WiMAX networks roll out," says English, "you're going to see more and more cost competition between wireless broadband, cable and DSL."



How WiMAX Works

1. One WiMAX antenna has a potential 30-mile range and a shared data rate of up to 70 megabits per second (Mbps). **2.** Initially, WiMAX will be a "fixed wireless" solution, with receiver antennas placed on buildings. Home users should expect bandwidth of around 1Mbps to 2Mbps. **3.** WiMAX is a scalable technology, allowing businesses to pay more for higher speed. **4.** In 2006, mobile WiMAX technology would be built into laptops, so you could take your broadband along on trains, buses and automobiles.

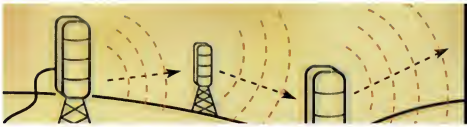
It's the second wave of WiMAX, however, that really promises to be transformative. By the end of 2006, hardware manufacturers hope to offer mobile WiMAX products that will let users tap into broadband from virtually anywhere. Full broadband mobility also would lay the ground for a new wave of electronic devices and services. Imagine a multimedia PDA that not only lets you check on the status of a flight while en route to the airport, but also lets you stream content from your TiVO to a PDA screen anywhere on Earth. In a WiMAX world, your broadband account would no longer be tied to your home. Like cellphone service, it would travel with you everywhere.

WiMAX should have a bright future in the States, but its impact could be

(Please turn to page 32)

ILLUSTRATION BY HARRY CAMPBELL

NSIST ON NVIDIA
PHOTOS
BETTER GAMES
ASPYR
ACTIVISION
LEFT FIELD
EVERYONE
Mild Lyrics
ESRB
EQUIP YOURSELF WITH NVIDIA, BECAUSE SLOW AND STEADY ONLY WINS THE RACE IN FAIRY TALES.
MTX MOTOTRAX
BEFORE TEARING OUT OF THE GATE, MAKE SURE YOU HAVE YOUR GEAR MODIFIED FOR SPEED, INCLUDING A PC EQUIPPED WITH AN NVIDIA GEFORCE GRAPHICS PROCESSOR. FOR BLAZING PERFORMANCE, ROCK-SOLID RELIABILITY, AND STUNNING PHOTOS AND VIDEOS, NSIST ON NVIDIA.®
The way it's meant to be played
NVIDIA.
www.aspyr.com/games.php/pc/mtxpc/
www.nvidia.com
BEST BUY
MTX: MOTOTRAX™ AND BFG'S GEFORCE 6800 AND 6800 GT GRAPHIC CARDS AVAILABLE AT BEST BUY.



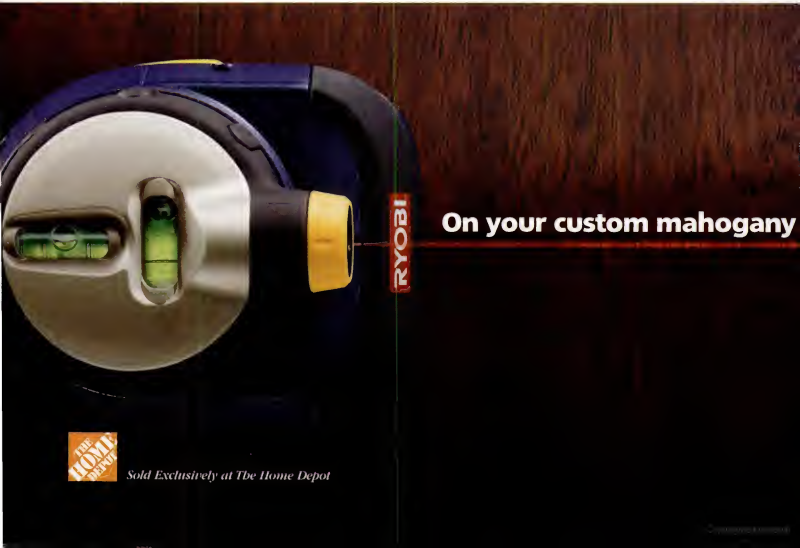
Hop, Skip and Jump
WiMAX "back haul" will allow each antenna to extend the network through remote and difficult terrain without laying new wires.

more profound in fast-growing nations such as China and India. "WiMAX has enormous potential in developing countries where the telephone infrastructure reaches less than 10 percent of the population," says Ron Resnick, president of the WiMAX Forum, an organization dedicated to promoting the standard.

With WiMAX, it's no longer necessary to lay most of the basic data pipes that link together a traditional telecommunications network. Signals can be bounced from base stations so that each tower not only services an area, but also extends the geographic reach of the overall network. Within years, developing nations could build telecommunications networks comparable to those that Westernized nations took decades to construct.

In the end, the most compelling reason to have faith in WiMAX is that the industry wants it to succeed. The WiMAX Forum has such heavyweight member companies as Motorola, British Telecom, Siemens, Nortel and Quest Communications. And most important, Intel has announced its intention to build WiMAX technology into the company's future chips, much as it has already integrated Wi-Fi. With that kind of commitment behind WiMAX, even the wilder crystal ball speculation starts to look like solid forecasting.

ILLUSTRATION BY HARRY CAMPBELL



Unlocked

This past fall, word spread that many Kryptonite bicycle locks, some retailing for as much as $90, could be picked in around 7 seconds with a 7-cent Bic pen. Was it really that easy? We gave it a shot and made quick work of this Kryptonite Extra Large Padlock with a Round Stic Bic, then sawed it open with an angle grinder. We showed the results to lock expert Marc Weber Tobias, author of *Locks, Safes And Security: An International Police Reference*.

According to Tobias, the problem is Kryptonite's tubular cylinder lock (called an axial pin tumbler by locksmiths). Bic pens just happen to fit perfectly into the cylinder, and the soft plastic of the pen molds, or "impressions," the inside of the lock.

What's worse, Tobias claims, there are many more Bic-pickable cylinders on the market, from competing brands of bicycle locks to locks on laptops to motorcycle ignition systems.

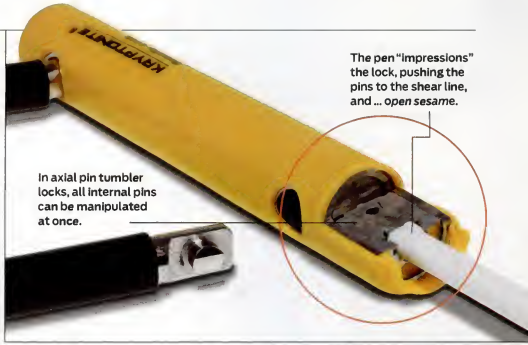


PHOTO BY LUCAS VISSER

Kryptonite is offering customers free exchanges for all of its tubular cylinder locks. —*Jonathan Gromer*

Our new AIRgrip Laser Level utilizes innovative vacuum technology, allowing you to attach the level to a variety of smooth surfaces without using pins or tacks. So when you're hanging paintings on expensive wallpaper or putting up chair rail on your custom paneling, you don't have to puncture what's priceless just to get a level. Just use AIRgrip. You'll never know it was there.

paneling. It's like it was never there.

AIRgrip™
Laser Level

Projects a laser line 270° and around corners. Adapts for tripod use and velcros to studs.

RYOBI

High-Definition Smack-Down

So you've updated your VHS to DVD, and upgraded your TV to HDTV. Unfortunately, DVDs don't hold nearly enough data to contain a feature-length high-def movie. So what will you be renting in the years to come? Here's the lowdown on the format war of the future. *—Jill Davis*

	DVD	HD-DVD	BLU-RAY	HOLOGRAPHIC VIDEO DISC
TECH SPECS	Uses a red laser with a wavelength of 605 nanometers	Uses a blue-violet laser with shorter wavelength of 405 nanometers	Uses a blue-violet laser with shorter wavelength of 405 nanometers	Uses two separate lasers and a 3D recording technology
>> ARRIVAL DATE	Available since 1997	2005	2005	2007 (?)
CAPACITY	**4.7** gigabytes (equals seven CDs)	**15-30** gigabytes (equals 21 to 42 CDs)	**25-50** gigabytes (equals 35 to 71 CDs)	**1** *claims up to* terabyte (equals 1428 CDs)
PLUSES	Still has 10-plus years of staying power; lots of content	Production process is similar to DVD's. Translation: cheap to make	Brand power: Most companies are rallying behind it. Higher disc capacity than HD-DVD	1 terabyte Any questions?
MINUSES	Won't give you high-def quality; easy to pirate	Few supporters include Toshiba, Sanyo and NEC	Complicated production process could lead to higher disc prices	Doesn't exist as a consumer product yet
OUT-OF-POCKET	At $50 and up, players are dirt-cheap	Players/recorders will start at around $1000	Players/recorders will hit the market at around $2500	Consumer products predicted to cost around $2000 to $3000
THE BOTTOM LINE	Until Blu-ray and HD-DVD finish fighting it out, DVD players are still the way to go	Fewer supporters and fewer gigs than Blu-ray may make it the blue-laser long shot	High number of backers in the electronics and movie industries may give it the edge	In the works for about 40 years, holographic optical discs are the holy grail of storage technologies

PHOTOS BY: ACE STOCK LIMITED/ALAMY (DVD, HD-DVD); LAWRENCE MANNING/CORBIS (HOLOGRAM)

Available all night.

©2004 P&G. Use as directed for cold/flu relief.

The best sleep you ever got with a cold... medicine.

POST-FLIGHT

The X Factors

How backyard engineering won the private space race.

BY DAVID NOLAND

THE recent epoch-al flights of *SpaceShipOne* may or may not herald a new age of space tourism. Indisputably, though, they were a dazzling triumph for aerospace designer and maverick genius Burt Rutan. Twice in five days his crude yet innovative craft rocketed up more than 100 kilometers (328,000 ft.) before gliding safely back to Earth, earning Rutan and his financial backer, Microsoft billionaire Paul Allen, the $10 million Ansari X Prize. While most reports lionized Rutan as an aeronautical visionary, what the flights really showcased was his backyard tinkerer's mentality.

SIMPLE VIRTUES

Rutan, previously known for his Voyager around-the-world aircraft, has a very firm design philosophy: Keep it simple, cheap and, above all, practical. Rutan's "wind tunnel," for example, is a Ford F-250 pickup. Instead of a complex system of compressors and sensors, *SpaceShipOne*'s "pressurization" system is essentially a couple of corks, two tanks of compressed air and an oxygen tank. The craft is sealed up tight before takeoff. It has a simple skid made of Canadian maple in place of a nose wheel. The only computers on board run the navigation system and the cockpit instrument display. NASA wouldn't dream of building something so primitive—and for Rutan, that's the whole point. "The complexity you remove can never fail," Rutan says.

FEATHERING

As the Space Shuttle *Columbia* so tragically demonstrated, re-entry into the Earth's atmosphere is the biggest hurdle for any space vehicle. To slow down from its Mach 3 re-entry speed, *SpaceShipOne* folds ingeniously in half like a beach chair, with the fuselage and front part of the wings rotating up 65° to present a wide, blunt surface to the onrushing air, slowing the craft at a gut-wrenching 5 g's. In this "feathered" mode, *SpaceShipOne* is stable at both supersonic and subsonic speeds, an astonishing design feat. (Rutan has named it "Care-Free" re-entry.) "The feathering capability is the absolute keystone that makes the whole project possible," says Mike Melvill, who flew the first X Prize flight. "It's a brilliant idea. Only Burt could come up with something like that."

THE WINNER: Designer Burt Rutan. Above: Pilot Brian Binnie celebrates.

HYBRID THRUST

The space shuttle uses solid-fuel boosters and a liquid-fuel main engine. *SpaceShipOne* burns both solid and liquid fuels in the same engine: solid hydroxy-terminated polybutadiene (HTPB) and liquid nitrous oxide (N_2O)—substances otherwise known as tire rubber and laughing gas. Although less powerful than the exotic fuels used in the space shuttle, HTPB and N_2O are cheap, nontoxic and explosion-proof. These mundane qualities make HTPB/N_2O hybrid rocket motors a mainstay of model rocket builders, a point not lost on Rutan, who is a lifelong model builder himself.

PHOTOS BY ROBYN BECK/GETTY IMAGES (RUTAN); HECTOR MATA/GETTY IMAGES (SPACESHIPONE)

RETRO FLIGHT CONTROL

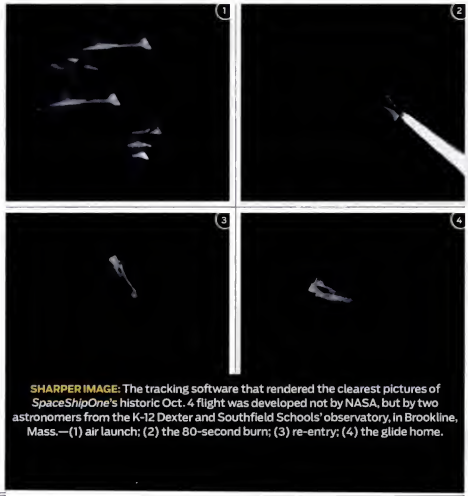
Back in 1947, as Chuck Yeager approached the speed of sound in the X-1 rocket plane, his elevator control locked up from the extreme aerodynamic forces. Thinking fast, Yeager used the electric trim to fly through Mach 1 for the first time. Rutan applied the same seat-of-the-pants concept to *SpaceShipOne*: The pilot uses a simple manual stick and rudder for subsonic flight, then switches to electric trim above Mach 1. (For altitude control in the airless reaches above 200,000 ft., there's something Yeager could only dream of—reaction thrusters.) Although some control problems arose—during the first X Prize flight the rocket unexpectedly rolled 29 times—*SpaceShipOne*'s final X Prize flight was flawless.

THE MOTHER SHIP

Air launching gives a head start into space and reduces the size requirements for a suborbital craft by a factor of two. It's not exactly a new idea—Yeager's X-1 took flight from the belly of a B-29 bomber—but an air launch is a daunting challenge for private rocketeers, who don't typically have access to multiengine jets with bomb-bay doors. Rutan designed and built his own mother ship, the White Knight, a spindly mantislike craft that hoisted *SpaceShipOne* to an altitude of 47,000 ft.

WHAT'S NEXT?

Now that the X Prize competition is over, the immediate future of *SpaceShipOne* is uncertain. "We're torn about flying it again," says Melvill. "We can always use more test-flight data, but the Smithsonian wants it, so it'd be a shame to crash." Meanwhile, Rutan is already forging ahead on *SpaceShipTwo*, a larger craft designed to carry four paying passengers. British airline mogul Sir Richard Branson, who's bankrolling the $100 million venture, calls Rutan's rocket the *Virgin Star Ship Enterprise*. He envisions commercial suborbital flights, at $190,000 a seat, starting in 2007. With Rutan adding the power of backyard engineering to the mix, don't bet against it. PM



SHARPER IMAGE: The tracking software that rendered the clearest pictures of *SpaceShipOne*'s historic Oct. 4 flight was developed not by NASA, but by two astronomers from the K-12 Dexter and Southfield Schools' observatory, in Brookline, Mass.—(1) air launch; (2) the 80-second burn; (3) re-entry; (4) the glide home.

PHOTOS BY 2004 DEXTER SOUTHFIELD SCHOOL/WORLD PICTURE NEWS

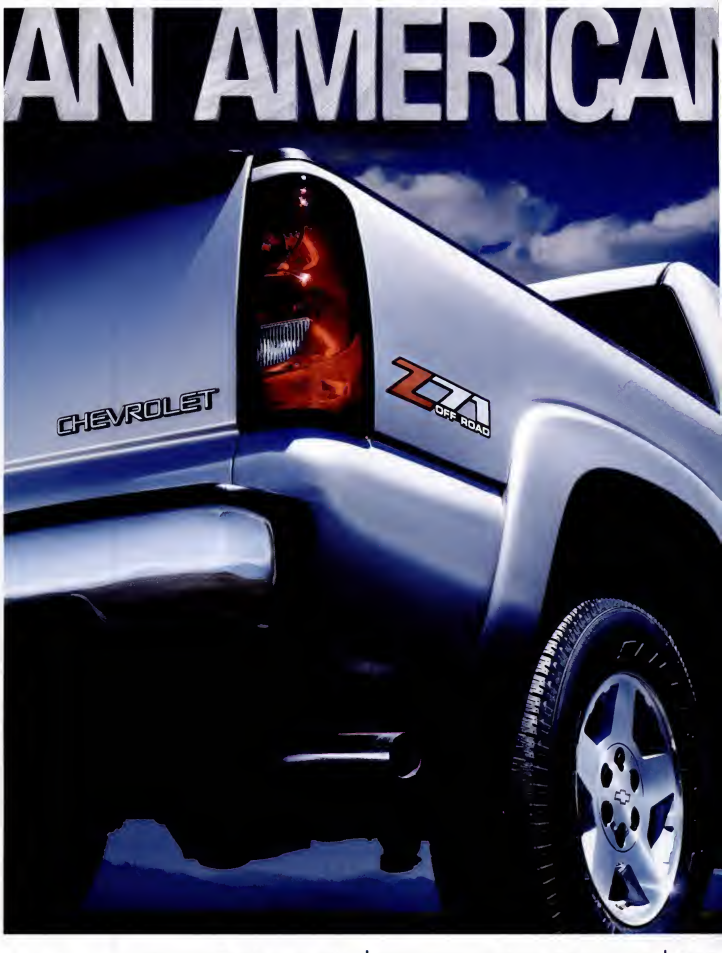
FACT:
SILVERADO® HALF-TON CREW HAS A POWERFUL VORTEC™ V8

FACT:
SILVERADO HALF-TON CREW HAS 295 HORSEPOWER STANDARD

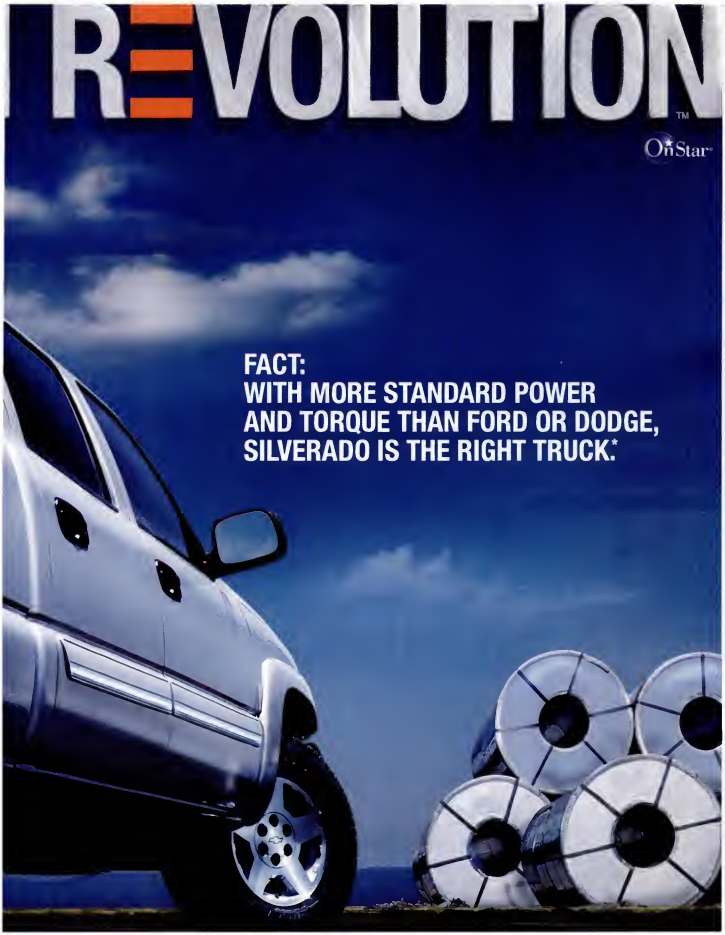
FACT:
SILVERADO HALF-TON CREW GENERATES 335 LB.-FT. OF TORQUE STANDARD

AN AMERICAN REVOLUTION

©2004 GM Corp. Buckle up, America!



SILVERADO PULL. TOW. HAUL. GLOAT. | 295-HORSEPOWER VORTEC™ V8 | MORE
DODGE CREW CABS* | DURABLE HYDROFORMED STEEL FRONT FRAME |



STANDARD TOWING CAPACITY THAN FORD OR

THE OFFICIAL TRUCK OF AN AMERICAN REVOLUTION

THE RIGHT TRUCK

Sat Radio

Take a satellite radio tour on our Southern road trip. **BY REBECCA DAY**

PHYSICALLY, the long stretch of country between New Orleans and the Florida Panhandle is mainly swampland, but when it comes to the radio, it's a desert. This is an insult to musical history: You expect—and deserve—a large helping of the bedeviled Robert Johnson and genuine Delta blues as you zip past billboards pushing swamp tours and Paw Paw's Camper City. Instead, not much beyond Big Easy city limits, the sound of Basin Street blues gives way to Top 40, Christian pop and prayer radio—and there's nothing to look forward to along Interstate 10 but 210 miles of disappointment.

I know this route well, so I saw a drive across Louisiana and the Mississippi and Alabama boot heels as an opportunity to delve deeper into the trendy world of satellite radio—which has become even trendier with the announcement by Howard Stern that he's moving to satellite radio in 2006. To do this properly I ran a road test on the two emerging powerhouses of the field, XM Radio and Sirius. Each of these subscription services provides listeners with more than 100 channels, with programming as broadly appealing as national weather forecasts and as targeted as bluegrass, world music and Broadway tunes. Whether you fancy talk radio, trucker banter or stand-up comedy, there's a channel—or two—to be found. In theory, at least, satellite radio is the antidote to a commercial radio culture that has dissolved into boring sameness in town after town.

I auditioned the portable Delphi XM Roady 2 service first. I started with the channel devoted to '60s music, and eased into vacation mode with "Li'l Red Riding Hood" by Sam the Sham and the Pharaohs. I hit 7 next, where I had preset the '70s channel, and cruised along to "Midnight Train To Georgia." Later, I switched to ESPN Radio in hopes of finding a baseball game, but got stuck with sports jabber instead. I was disappointed with Radio Classics when I couldn't understand the dialogue on "The Shadow" through the fuzzy rental car speakers. So I settled into XM Café, a satisfying blend of folk and alternative music.

So far, so good. At a Waffle House in Alabama, I switched to the Sirius Sportster—another portable option—but not before sustaining a jagged cut on the wrist as I hacked through the plastic clamshell with scissors. The industry has to come up with better packaging.

Sportster is geared to football fans who can enjoy Sirius's package of NFL games. I selected the Green Bay Packers from the menu as my favorite team so now whenever I turn on Sportster, the team's logo comes up. Even better, when it's game time, I'm alerted by a beep telling me to change channels. The real-time score is displayed on the screen along with the quarter being played. That was cool while the Packers were up 3-0, damned annoying when the Bears went ahead to win 21-10.

Another Sirius exclusive that I really enjoyed was the Elvis channel, which delivers the King's vast repertoire of rockabilly, gospel and rock-and-roll 24/7 from a studio at Graceland.

(Please turn to page 43)

ILLUSTRATION BY PETER HOEY

Another item you can cross off your list.

Theresa and her son, **Luke**
Wal-Mart Customers

The ink supplies you need at the prices you expect.

WAL★MART®
ALWAYS LOW PRICES.
Always

Walmart.com

Ask for details about Wal-Mart's ink cartridge recycling program.

© 2004 Wal-Mart Stores, Inc.

SPECIAL OPS

Worn by Special Ops and SWAT teams worldwide

Now available to the public

Solid Stainless Steel
Watch and Band
330ft Water Resistant
Screw Down Crown
Scratch Resistant Crystal
Carbon Fibre Dial
Super Luminous Numbers

STAINLESS STEEL
BLACK FINISH

STAINLESS STEEL
CHROME FINISH

SPECIAL OPS WATCH **RETAIL VALUE - $595**

MENTION THIS AD TO GET SOECIAL OFFER AT ONLY $395

CHARGER INCLUDED

INTERNAL LIGHT MODE

EXTERNAL LIGHT MODE

WATCH

Quartz Frequency	32,768 Hz
Accuracy	Within ±20 seconds per month under normal temperature (+5°C to +35°C). Depending on surrounding temperature, this range may be exceeded during charging.
Operating Temperature Range	-5°C to +55°C
Storage Temperature Range	-10°C to +60°C
Other	Overcharge protection; low battery alert
Battery Life	Approximately 1 month (on a full charge, one dial illumination and external illumination operation per day). Actual battery life depends on operating conditions.
Illumination (LED)	Dual-illumination: Approx. 5 seconds External illumination: Approx. 20 seconds
Driving System	Stepping motor
Battery	Secondary Li-ION batteries
Watch Weight	7.0 oz.
Dimensions	45 mm (W)

INTERNAL LIGHT MODE: LIGHTS UP THE DIAL
EXTERNAL LIGHT MODE: BRIGHTEST LIGHT EVER IN A WATCH
CAN BE SEEN UP TO ONE MILE IN THE DARK
USED BY TACTICAL TEAMS TO LIGHT UP MAPS
ALSO USED FOR SURVIVAL/DISTRESS SIGNAL AND
MANY OTHER PURPOSES AND FUNCTIONS
ELECTROMAGNETIC RECHARGEABLE BATTERY
(CHARGER INCLUDED)
WATCH CAN BE CHARGED JUST BY PLACING THE WATCH
ON THE CHARGER OVERNIGHT (SEE PICTURE)
10 YEAR RECHARGEABLE LITHIUM BATTERY
ADJUSTABLE BAND USING AN ALLEN KEY SUPPLIED
10 YEAR LIMITED WARRANTY
LIMITED EDITION INDIVIDUALLY NUMBERED

For Credit Card Orders Call 1-800-862-6772 Outside the USA 213-765-0765

WWW.SPECIALOPSWATCH.COM

AMERICAN WATCH COMPANY. 1225 SOUTH GRAND AVE. LOS ANGELES, CA 90015

120 CHANNELS

SIRIUS SATELLITE RADIO

MUSIC: 65 music channels including 13 pop, 17 rock, six country, six jazz/standards, four hip-hop, five Latin and world.

TALK/ENTERTAINMENT: 24 talk channels and eight sports (which carry the play-by-play of more than 23 college teams). Includes ESPN Radio and, soon, Howard Stern.

NEWS: 14 news channels including Fox News Channel and NPR Talk.

TRAFFIC AND WEATHER: 10 traffic and weather channels covering 20 cities.

PREMIUM: Sirius has no premium channels.

OUR FAVES: The Elvis station is super for about five songs in a row, longer for true die-hards. When it comes to political talk, the SiriusLeft channel offers plenty to ponder while cruising the byways. You may prefer the Sirius Patriot channel for a more right-wing bent.

BOTTOM LINE: Definitely best for the sports fan—I loved listening to the Packers while on the road. And for $12.95, this kind of coverage is worth it.

Of course, it's important to remember that most people enjoying satellite radio in their cars today are using hardware that is permanently installed. But since I was trying both services out, I was reduced to using portable versions of the technology. With both systems, this route is a lot messier than using the installed hardware, but for you, dear reader, it was worth it. The upside is you can connect the portables to your home stereo with optional kits, which is cheaper than paying for dual subscriptions.

Both units worked well, providing good reception and sound quality, but there were some differences. With XM Roady 2, the listener scrolls through the 137 stations using a jog wheel and presses the wheel to choose one. Now, I don't like jog wheels because my finger tends to slip when I try to make a selection, and I end up tuning to the wrong station. The rotary tuning knob on the Sirius Sportster is more finger-friendly.

However, I appreciated the compactness of Roady. The body is as small as a deck of cards and the antenna is no bigger than a half dollar. Sportster is about a third larger than Roady. While that helps make the display easier to read, the design

(Please turn to page 45)

Inner strength

The miracle is on the inside...

Our bed utilizes natural principles of physics. Nothing mechanical or electrical. No motors, switches, valves, air pumps, or water heaters. It can't break, leak, short-circuit, or stop working. It needs no rotating, turning, or flipping.

Yet, it has to be *felt* to be believed!

Our sleep technology is recognized by NASA, raved about by the media. Ours is the *only* mattress recommended worldwide by over 25,000 medical professionals.

THE ONLY MATTRESS RECOGNIZED BY NASA AND CERTIFIED BY THE SPACE FOUNDATION ✦

While the thick, ornate pads that cover most mattresses are necessary to keep the hard steel springs inside, they create a hammock effect outside—and can actually *cause* pressure points. Inside *our bed*, billions of microporoscopic memory cells function as "molecular springs" that contour *precisely* to your every curve and angle.

Tempur-Pedic's Swedish scientists used NASA's early anti-G-force research to invent TEMPUR® pressure-relieving material—a remarkable new kind of viscoelastic bedding that *reacts* to body mass and temperature. It *automatically adjusts* to your exact shape and weight. And it's the reason why millions of Americans are falling in love with the first *really* new bed in 75 years: our high-tech Weightless Sleep™ marvel.

No wonder, 9 out of 10 enthusiastic Tempur-Pedic owners go out of their way to recommend our Swedish Sleep System® to close friends and relatives. And, 92% tell us their Tempur-Pedic is far superior to older innerspring, air, and waterbeds.

Please telephone us toll-free, without the slightest obligation, for a FREE DEMONSTRATION KIT!

Owner survey conducted by Alpert O'Neil Tigre & Co. August 2003

Free Sample/Free Video/Free Info

FREE IN-HOME TRYOUT CERTIFICATE

YOURS FOR THE ASKING!

For free demonstration kit, call toll-free

888-359-8492

or send fax 866-795-9367

TEMPUR-PEDIC®

PRESSURE RELIEVING SWEDISH MATTRESSES AND PILLOWS

TPX NYSE

© Copyright 2004 by Tempur-Pedic Direct Response, Inc. All Rights Reserved. 1713 Joggie Fitts Way, Lexington, KY 40511

137 CHANNELS

SATELLITE RADIO

MUSIC: 68 music channels including 15 rock, seven urban, five jazz and blues, seven country, three Christian and three classical.

TALK/ENTERTAINMENT: 27 talk channels split into 12 entertainment and 15 sports. Includes Big Ten Sports and I Want My MTV—RADIO.

NEWS: 12 news channels including Breaking Stories From Around The World and CNN in Spanish.

TRAFFIC AND WEATHER: 22 traffic and weather channels including the XM Emergency Alert Channel.

PREMIUM: Two premium channels—The Opie And Anthony Show ($1.99/month) and Playboy Radio ($2.99/month).

OUR FAVES: For music, XM Café offers an eclectic blend of blues, alternative and folk music. Bluesville is one of those rare stations that plays true American blues music 24/7. In the morning, former NPR talker Bob Edwards holds forth on Channel 133.

BOTTOM LINE: With stations offering tunes from the '70s, '80s and '90s, the variety of music was good, but it's really the $9.99 price tag that makes XM a good deal.

reminds me of an '80s-era Walkman, and the antenna has an 8-in. tail.

Again, using installed satellite radio equipment is a much easier option.

XM has a slight pricing edge at $9.99 a month versus $12.95 for Sirius. A one-year Sirius commitment discounts to $142.45 a year, compared with XM's $119.88. Sirius used to have sole bragging rights for commercial-free music, but XM matched that offering—a welcome example of the benefits of competition. XM has commercials on news, sports and entertainment channels. Sirius has program announcements on these channels.

One could split hairs over these pricing and product design differences, but for me a buying decision would come down to programming. I like the Sinatra channel (Frank's Place) on XM and the terrific Elvis channel from Sirius. I prefer the rock and jazz channels from Sirius, but I'm a big fan of XM Café. The fact that both offer a few classical options is great, considering the sad state of serious music on commercial radio. But either service still has the opportunity to win my dollars: The tipping point will be whichever service offers full Major League Baseball coverage first. PM

COMPUTERS

Logging Into Linux

Free software? Here's the scoop. **BY GREG SEWELL**

WITH a personal computer operating system (OS) market share over 90 percent, Microsoft Windows dominates the world's home computers. It is the Coke, Kleenex and Heinz ketchup of computing. Apple's operating system comes in a distant but respectable second place in the home PC market.

And yet, despite the dominance of those two systems, almost any computer geek will tell you that Linux—the free operating system built by a global army of skillful and passionate programmers—is far and away a better way to power your PC.

Linux used to require typing in complex commands to get anything done—but not anymore. To make it more consumer friendly, a few companies have put a more human user interface on Linux, employing the menus, windows and mouse clicks familiar to any user of Windows. I wanted to find out just what all the fuss was about and if my geek friends were telling the truth—that Linux truly is a consumer alternative to the Windows behemoth. So I installed Linux on an IBM ThinkPad previously running Windows 98 and took it for a test drive. And after a few weeks playing around with Linux, I'm convinced. Linux measures up.

WHICH LINUX?

First, I had to decide which version of Linux to use. Because Linux is open source (see sidebar below), anyone can create their own version and put it on the Net. That means hundreds of versions to choose from. But, only a few of the many available offer the easy navigation required by nonprogrammers.

You can download most versions of Linux for free or order a CD-ROM for a couple of dollars. I was willing to pay $29.95 for the version I chose: the CD-ROM of SUSE Linux 9.1 Personal Edition (www.suse.com). This came with some technical support and basic applications included in one easy-to-install package. It also was bundled with free software including OpenOffice (which works just like Microsoft Office), a Web browser, an e-mail program, and multimedia tools like CD burning and a photo editor.

INSTALLING

After configuring my laptop to start up from the CD-ROM drive rather than the hard drive, the installation went smoothly. My hard drive was reconfigured automatically to allow me to run either Linux or Windows, and all the software was installed.

But by the end of the installation I realized I had already surrendered to Linux. Setup recommendations like "Resize Windows partition c:(/dev/hda1) from 17.8GB to 6.8GB" make little sense to the uninitiated and I simply clicked through them hoping for the best. The only setting I felt comfortable changing was my time zone.

Programming, Libertarian Style

OPEN SOURCE simply refers to software that anyone can look at, download and modify. Open source traces its roots back to the 1960s hacker culture of U.S. computer science labs that were looking to skirt the corporate culture of imposing computer giants (i.e., the future Bill Gates). The point is to foster community and cooperation, and ultimately create better, free software. To make sure this philosophy stuck, licenses like the GNU General Public Licensing (GPL) were created. GNU is an acronym that actually refers to itself in the expression it stands for. Recursive acronyms were used during the early hacker years to show the movement's playfully clever spirit. GNU really means "GNU's Not Unix." So the GNU GPL is a software license that makes sure free software stays free.

ILLUSTRATION BY BRIAN STAUFFER

FINDING MY WAY

If you know your way around a Windows or Mac OS computer, the SUSE desktop will look and feel very familiar. There are icons called My Computer and Trash, and even control panels that let you set the look and layout of your desktop.

The menus and toolbars in OpenOffice look and work just like Microsoft Office commands, and I could easily save my text documents as Microsoft Word files.

PLUGGING AND PLAYING

To try out the image-editing software, I plugged my digital camera into the USB port and Linux instantly recognized it. I dragged a photo to my desktop, opened it in a piece of software called The Gimp 2.0, and played with it until it looked nothing like the original. The Gimp appeared to be just as powerful as Photoshop—but it's free.

I put in a music CD and that too worked flawlessly, playing music through the free CD player.

GETTING ONLINE

One of the main issues with running Linux is that all the software you use needs to be created just for Linux—and not every company makes such software. AOL isn't available for Linux. Neither is Windows Media Player, meaning that any streaming media on the Internet that uses the Windows Media Player format cannot be seen or heard on a Linux computer without installing MPlayer software.

As for getting connected to the Web with Linux, it depends on how you plan to do it. Luckily, I have DSL access at home and configuring my Linux laptop to access the Net through the DSL connection was simple. SUSE comes with built-in tools to walk you through the process of setting up a broadband connection.

THE LINUX LIFESTYLE

Getting comfortable with Linux can be awkward at first, but if you use Windows, can install software and do basic troubleshooting, switching to Linux will be easy.

And the benefits can be great. Unlike Windows PCs, Linux software upgrades are almost always free. It almost never crashes. And not only is Linux less vulnerable to hackers, but because much of the world runs Windows, most hackers and virus writers target that operating system.

I like Linux. It has caught up to Windows in its ease of use and has long been ahead in terms of reliability. And until Microsoft starts giving away their software for free, I think I'll stick with my new, improved operating system. PM

King Of The Load

We put a Ford Super Duty to work hauling some serious cargo. **BY MIKE ALLEN**

BRAGGING rights are important because we all want to tell the world—or at least the immediate vicinity—how fast, or quick, or strong or long lasting our truck is. Bragging rights in the pickup field right now center not on horsepower or 0-to-60 times, but on a less likely attribute—towing capacity. Properly outfitted with a fifth-wheel hitch, the latest big boy is the Ford F-250 Super Duty, rated for pulling a staggering 17,000 pounds of road-hugging weight.

With Ford having thrown down the gauntlet at the rest of the heavy-duty pickup crowd, we decided to pick it up and take a road trip. We called over to Roush Racing and offered to ferry a pair of their Nextel Cup stock cars around the Southeast for a couple of races, in exchange for some free tickets. When they stopped laughing, they did agree to let us tow some cars for them if we promised to be careful.

So we hopped a plane to Charlotte, N.C., to meet up with a new King Ranch F-250 duallie. Hooked to the center of the bed was a 42-ft. two-car trailer, with an all-up weight just a touch over 11,000 pounds. While this is far less than the Super Duty's max capacity, it's still enough mass to make little beads of sweat stand out on your forehead as you're headed for Lowe's Motor Speedway with a couple hundred grand of somebody else's race cars that you've signed for.

Or not. In truth, the Super Duty did its job well, making ours easier. Powered by the 325-hp 6.0-liter Power

WHO'S THE BOSS?

Ford F-250 Super Duty: 17,000 pounds
Chevrolet Silverado H-D: 16,700 pounds
GMC Sierra H-D: 16,700 pounds
Dodge Ram H-D: 16,400 pounds
Nissan Titan: 9500 pounds
Toyota Tundra: 7100 pounds

ROW, ROW, ROW YOUR TRUCK: The Super Duty is available with a six-speed manual or five-speed automatic trans and one of three rear-axle ratios. Tow/Haul mode on the auto changes shift points for better acceleration and improved speed control on downhills.

MATCHING DRAPES AND RUGS: This is a King Ranch model. The Super Duty is also available in Lariat and XLT Sport trim levels.

GRUNT WORK: Power up with a 5.4-liter 24-valve 300-hp/365-lb.-ft. V8, a 6.8-liter 30-valve 355-hp/455-lb.-ft. V10, or a Power Stroke 6.0-liter 32-valve 325-hp/570-lb.-ft. diesel V8.

PHOTO BY MIKE ALLEN

(Please turn to page 50)

NOW YOU JUST NEED TO STICK THE LANDING.

Serving in the Army National Guard is no spectator sport. Whether you're on the confidence course, driving a 60-ton M1 tank, or serving to defend freedom, you're at the center of the action.

Contact us today for your free DVD and more information on how to get moving.

ARMY NATIONAL GUARD

YOU CAN

1-800-GO-GUARD • www.1-800-GO-GUARD.com

> If you decide to quit smoking, this is a good place to start.

If you're quitting smoking, this 48-page guide can help. It points the way to a wealth of expert information from public health authorities and others, including:

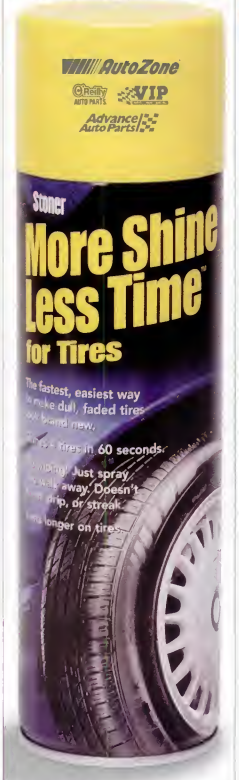
- > Links to quitting websites
- > Quitting guides
- > Telephone quitlines
- > What's worked for others
- > And much more...

The QuitAssist™ Resource Guide. Get a free copy today. Visit QuitAssist Online at **philipmorrisusa.com** or call **1-888-784-7848**.

QuitAssist™
Information Resource
Philip Morris USA

©2004 Philip Morris USA

Now available at leading auto parts stores:



"Lasts Longer on Tires"

More Shine Less Time for Tires™ (MSLT) is the fastest and easiest way to make your tires look their best. This long-lasting, spray-on coating makes dull, faded tires look brand new in seconds. *MSLT* is preferred by professional auto detailers, finicky car collectors, dealers, and enthusiasts!

MSLT is not a messy foam or drippy liquid. This easy-to-use aerosol needs no wiping. Apply 1 coat for a dull satin finish, 2 coats for high gloss. Takes just 15 seconds per tire, won't harm wheels or paint, and gives UV protection.

Other brands don't last because they're made with water and surfactants (soaps) that evaporate and wash off easily with water. *MSLT* contains no surfactants or water so it lasts longer, and won't brown tires. One application of *MSLT* lasts weeks on tires. Learn more, and find other retail stores at:

mslt4tires.com

Stoner Inc. • 1070 Robert Fulton Hwy. • Quarryville, PA 17566 • 1-866-STONER1 • code # MPM0U

Stroke Diesel V8, the King Ranch was easily capable of matching normal traffic speeds on freeway on ramps and up hills. We kept checking the mirrors to see if the trailer was still with us. You can also spec a 5.4-liter V8 with 300 hp or a 6.8-liter V10 with 355 hp.

Speaking of mirrors, the King Ranch model comes standard with several towing accessories, starting with the electrically extendible mirrors that run in and out about 6 in. In for normal civilian use, out for towing. Ford has taken electric trailer brakes to a new level, with the trailer-brake controller integrated into the hydraulics and the ABS for smooth trailer-brake operation. The controller is speed-sensitive, so high-rate panic stops are aggressive while parking-lot maneuvers are smooth enough to avoid spilling your coffee. ABS integration means the trailer brakes won't lock and skid sideways if you hammer the pedal hard enough to activate the ABS. The controller is even integrated into the dash, rather than being bolted to the bottom of it like an afterthought. The front suspension of 4wd Super Dutys now uses coils instead of leaf springs, for increased roll stiffness and reduced suspension pitching over bumps, particularly while plowing snow. It also has a 5.5-ft. narrower turn circle.

JUST CARGO: Even a Nextel Cup car is nothing but expensive cargo that must be trailered to each race.

We gave Mr. Roush his race cars back at the end of the day. The driver who was ferrying them to their next appointment towed them away. And wouldn't you know it? He was driving a new Super Duty.

PHOTO BY MIKE ALLEN

(Please turn to page 52)

We found our best watch in a history book

In 1922, a small watchmaker in Switzerland designed the first automatic watch to display the day, month and date. Only 7 of these magnificent timepieces were ever made and this watch was almost lost to history. Today, they are so rare that our watch historians are willing to bid $300,000 for an original in mint condition.

These watches were among the most stylish of the roaring 20's. The Stauer watch design that you see here has the antique color, the vintage style and the innovative functions of the original that we have seen in a Swiss museum. Even the Breguet™ style hands are designed from the original. The owner of this legendary multi-functional watch is sure to look distinguished and set apart from the crowd. This Stauer watch is a limited edition, allowing you to wear a watch far more exclusive than many luxury brands.

The watch has a 24-jewel mechanical movement, the kind desired by fine antique watch collectors. We have updated this movement with an automatic rotor thus the watch never needs to be manually wound. The watch comes in a beautiful crocodile embossed case with a free second band.

This is a chance to claim a piece of watchmaking history in an elegant design that is still priced to wear every day. This offer is being made directly to you so you can add this watch to your collection at a very affordable price. The watch comes with a 30-day no questions asked money-back guarantee. If you're not completely satisfied, simply return it for a full refund of the purchase price.

Now available for the first time at $99

Not Available in Stores

Call now to take advantage of this limited offer.

Stauer 1922 ~~$147~~

3 Payments of $33+S&H

800-859-6584

Promotional Code SNN431-10

Please mention this when you call.

To order by mail, please call for details.

NEXTTEN

products for your next ten years.

14101 Southcross Drive W., Dept. SNN431-10
Burnsville, Minnesota 55337

For fastest service, call toll-free 24 hours a day **800-859-6584**

Learn more about the history of this 1922 classic at www.Nextten.com

Advertisement

Get a Smart Start Before Buying

Tips to make smart choices for your home — inside and out

HOME: Stay Cool When Choosing an AC Today's central air systems are much more energy efficient than ever. Look for the Seasonal Energy Efficiency Rating, or SEER. The larger the SEER number, the more cost-efficient the unit will be to operate.

HOME THEATER: Consider Shelf Space. You might not have room for a five-piece speaker system. Without a certain amount of separation you won't get the full effect. Look for systems that come with wall brackets or opt for floor speakers.

AUTO: Buy From Someone You Know. Looking through the classifieds to buy a pre-owned vehicle can be discouraging. Buy with confidence. Every GM Certified Used Vehicle comes with:

- 110+ Point Inspection
- 3-Month/3,000 Mile Comprehensive Limited Warranty
- 3-Day/150-Mile Satisfaction Guarantee
- 24-Hour Roadside Assistance

CHEVROLET · PONTIAC
OLDSMOBILE · BUICK · GMC

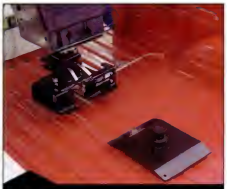
THE RIGHT WAY. THE RIGHT CAR.®

1-888-999-7880 • gmcertified.com

ALONG FOR THE RIDE: TOWING TIPS

DON'T confuse towing with ordinary driving—it requires a far higher level of preparation, awareness and effort than driving around in civilian guise. Some pointers:

- **Tire pressures, on both the trailer and the tow vehicle, are more critical than usual. Professional drivers check tire pressures daily. A low tire will make the rig more difficult to handle, particularly in a crosswind, and degrade braking distances. Heat builds up rapidly in a tire even a few percent below its correct pressure, making the tire wear rapidly and become prone to blowout.**
- **Everything in or on the rig needs to be tied down properly. That means locks or bungees on the kitchen cabinets, and heavy-duty tiedowns on the dirt bikes or four-wheeler.**
- **Wheel bearings on trailers live a short, brutal life, particularly on boat trailers that are immersed periodically in water, fresh or salt. Check for hot bearings with your hands on the bearing cap at every fuel stop. Repack with fresh grease every season.**
- **Checking trailer lights is easy. Turn on the parking lamps to check the running lamps. Then, turn on the four-way flashers to check both turn signals at the same time.**
- **Use dielectric grease on the trailer's electrical connection at the hitch, and on any underbody connections. Also apply a generous amount in all the light sockets on the trailer to prevent corrosion.**
- **Be sure the battery in the trailer's breakaway emergency-brake circuit is charged.**
- **Don't use chain left over from the swing set for safety chains—use proper hardened chains and snap-hooks (not S-hooks).**
- **Cross the chains under the tongue to keep the hitch from digging into the ground if it pops off the ball.**
- **Tongue weight on a hitch-type trailer is crucial: 10 to 15 percent of the trailer weight should rest on the hitch to reduce swaying. Don't guess—find a set of scales and check. If the correct tongue weight is too much for your suspension to handle, upgrade to an equalizing hitch.**
- **Any trailer that weighs more than the truck towing it probably should be a fifth-wheel. Fifth-wheel hitches are essential for maximizing the towing ability of any big pickup. Trouble is, with the fifth wheel sitting in the middle of the bed, there's precious little room for anything else back there. So unless you intend to use your heavy-duty hauler for towing only, you're faced with what amounts to a partial-use rig.**



UPSIDE DOWN: Putting the fifth wheel on the trailer frees the bed.

If you tow occasionally, you can remove and install the fifth wheel as needed. Or you can opt for a reverse-fifth-wheel setup. These units, like the Freedom Hitch from Putnam (www.putnamhitch.com), shown above, have an upside down fifth wheel that attaches permanently to the trailer and a quick-disconnect mount in the bed of the truck to lock the wheel to the truck. The hitch framework is mounted on the underside of the cargo bed. The receiver is on an adapter inside the cargo bed that attaches to the frame through a hole in the middle of the bed and is held by a locking pin.

Similar arrangements are available for gooseneck trailer hitches for large travel trailers. PM

©2004 GM Corp. All rights reserved. Buckle up, America!

Buying a GM Certified Used Vehicle is always a good decision. They're from the GM brands you trust. Plus, each one gets a 110+ Point Inspection, a 3-Month/3,000-Mile Comprehensive Limited Warranty, 24-Hour GM Roadside Assistance and a 3-Day/150-Mile Satisfaction Guarantee. To learn more about GM Certified, call 1-888-999-7880 or check out over 80,000 GM Certified Used Vehicles at gmcertified.com.

CHEVROLET PONTIAC OLDSMOBILE BUICK GMC THE RIGHT WAY. THE RIGHT CAR.®

NEW CAR REPORTS

Hot-Rod Hybrid

Honda builds a hybrid with moxie.

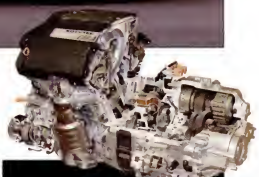
Until recently the hybrid's mission was to get better fuel economy than a vehicle with a gasoline engine while delivering a cruising range well beyond that of a pure electric. Not anymore. Carmakers have realized that instead of replacing some gas power with electric power to save fuel, they can simply add the electric power on top of an existing internal-combustion engine and get a real performance benefit *and* a fuel economy improvement. With the 2005 Accord Hybrid, Honda has created a family sedan that's quicker than its V6 counterpart, handles just as well and delivers a 43 percent gain in fuel economy. Instead of using a four-cylinder engine coupled to Honda's Integrated Motor Assist electric drive, the Accord Hybrid has it and a 240-hp 3.0-liter V6 mated to a five-speed automatic.

With the V6 and electric motor, you get what amounts to a combined 255 hp and 232 lb.-ft. of torque. That's a gain of 15 hp and 20 lb.-ft. of torque over a standard-issue V6-powered Accord. Better still, the instant torque provided by the electric motor lets you move the car in a hurry right off idle. In familiar terms that means this hybrid can smoke its tires off the line. Honda says the Hybrid is a half-second quicker than the Accord V6 from 0 to 60 mph.

To further improve fuel economy, Honda equipped the V6 with its Variable Cylinder Management, introduced on the Odyssey minivan. Under lighter loads or cruising, the V6 runs on three cylinders. As with the Civic Hybrid, the Accord's engine shuts off when stopped. But unlike the Civic, the a/c continues to run when the engine is stopped—a huge improvement. All this results in a fuel economy rating of 30 mpg in the city and 37 on the highway. That's up 9 mpg in the city and 7 mpg on the highway. You can drive up to 633 miles between fill-ups. Generous use of aluminum in the hood, bumper frames and rear-suspension knuckles means the Hybrid weighs only 120 pounds more than a regular Accord V6. However, because of the battery-pack location, total trunk volume has been reduced by 2.8 cu. ft. Expect to pay about $3000 more than you would for a regular Accord V6, or around $30,000 for the Hybrid. *Ben Stewart*

(Please turn to page 56)

"The Accord Hybrid offers a 43 percent fuel economy gain."



ONE NEAT PACKAGE: Sitting under the hood are a V6, a small electric and a 5-speed auto.

OUR STAND

ANY INSURANCE COMPANY WILL PAY TO HAVE YOUR CAR FIXED.

WE'LL PAY TO HAVE IT STAY FIXED.

Guaranteed workmanship.
One more reason over 1 million people switched to Allstate last year.

When Allstate pays to have your car repaired at one of our recommended shops, we guarantee the workmanship for as long as you own your car. So we'll pay what it takes to have the work done right. Think insurance this good costs a lot? Surprisingly, in many cases Allstate costs less than so-called "no-frills" insurance companies. **Are you in Good Hands®? Call now to find out how much our knowledge and experience can help you save.**

PEOPLE WHO SWITCHED **SAVED $278*** A YEAR ON AVERAGE

CALL NOW FOR A FREE QUOTE

1-866-232-9209

HAVE YOUR CURRENT POLICY AND DRIVER'S LICENSE HANDY
FOR AN ONLINE QUOTE GO TO **www.AllstateStand.com**

Allstate.
You're in good hands.

*Savings information reported by 4,103 new customers who purchased directly from an Allstate Customer Information Center. Actual savings will vary.

Subject to availability and qualifications. Online quotes not available in every state. Workmanship guarantee subject to specific terms. Allstate Insurance Company, Allstate Property and Casualty Insurance Company, and Allstate Indemnity Company, Northbrook, IL. The "Allstate Good Hands" logo is a registered service mark and "Our Stand" is a service mark of Allstate Insurance Company. © 2004 Allstate Insurance Company

BIG DOG: The CXT can all but carry other pickups.

Pick Up More

FOR those who simply have to have the biggest, meanest, most capable pickup truck on the block—okay, in four counties—here's the International CXT. Those letters stand for Commercial Extreme Truck and they're appropriate. The CXT is built on the same 20-ton hauler platform that International uses for dumptrucks and other severe-service vehicles. Thanks to its heritage, the CXT has airbrakes, an air-suspension cab and air-suspension front seats. Though there's a choice of powerplants, the featured drivetrain is an International DT 466 turbocharged diesel mated to an Allison automatic. The DT 466 delivers 220 hp and 540 lb.-ft. of torque. The 4wd CXT may not beat anyone from a stoplight, but there's not much that can stop it, either.

The pickup bed is fashioned from a Ford unit and its size, rather than the cargo's weight, is the limiting factor for how much the CXT can haul. Besides different engines, the five-person CXT can be equipped with a variety of luxury options including XM Satellite Radio, a drop-down DVD player, and a rear-facing camera for improved safety when going backward. International intends to build only about five dozen CXTs, primarily for business owners who want a truck that not only works for them but also offers a bodacious presence. If you're thinking of buying one for whatever reason, expect to part with anywhere between $95,000 and about $110,000. And you'd better have the right driver's license endorsement to drive a heavy rig. *Don Chaikin*

DETROIT SPY REPORT

BY JIM DUNNE

More Than A Nip And A Tuck

CADILLAC is planning a bit more than the usual minor facelift for the 2006 edition of its DeVille. There will be a new nose—complete with a different look to the grille and retrimmed headlights—some bulking up of the fenders and a reconfigured rear end. The most noticeable among the revisions is the grille, which sports fewer bands and has an oversize Cadillac badge in the center. Overall, the differences add up to a slightly more edgy appearance, balanced by the softer surfaces of the carryover doors and roof. Changes to the rear of the car might be more difficult to discern. The relocated license plate eliminates the bright metal frame that now sits on the decklid. The reversing lights are in the new, flat bumper face. The trunklid boasts a large Cadillac crest and wreath, matching the one in the grille. Slight changes in the rear fenders are the result of revisions in the size of the taillights and a new arrangement for the bumper.

Perhaps more meaningful than the DeVille's new looks is what is not new—its drivetrain. Unlike other new Cadillacs, the DeVille remains purely front-wheel drive. The DeVille can continue to share its chassis with the Buick LeSabre.

STILL IN THE FAMILY: New nose. New tail. Broader shoulders.

Command Central

AS the arrival of the 2007 Jeep Commander draws closer, more prototypes are running the public roads. Despite the number of test vehicles out there, Jeep engineers are still keeping their creation under thick wraps. Even with the heavy camouflage, you can see that this vehicle has a windshield and side glass that are more upright than a Grand Cherokee's. You also can see that there's enough rear overhang to accommodate a third-row seat.

(Please turn to page 58)

A BIGGER BOX: Jeep will match competitors in the seating war.

PHOTOS BY JIM DUNNE (DETROIT SPY)

silverstar®
HIGH PERFORMANCE LIGHTING

See where you're going long before you get there.

Change up to a pair of SilverStar High Performance Headlights for the whitest light. Whiter light helps you see better at night. And if your night vision is better, night driving is safer.

Standard Halogen

SYLVANIA SilverStar®

© 2004 OSRAM SYLVANIA

CHECKER
SCHUCK'S
KRAGEN
O'Reilly AUTO PARTS
NAPA AUTO PARTS
AutoZone
Advance Auto Parts
PEP BOYS

SYLVANIA

NEW CAR REPORTS

EXPOSER: Hero Blue Translucid air box cover and flyscreen are made of see-through plastic.

Naked Street Fighter

Buell crosses over and bears it all.

BUILDING on its Lightning platform, Buell unleashes the CityX (say "city cross") XB9SX for 2005. A stoplight warrior, the CityX is small, light and torquey, making it ideal for zipping safely past taxicabs and buses in the urban jungle. Flashy cosmetics include air box and instrument mechanicals on display through translucent plastic, while a headlight grille and handlebar deflectors add attitude and function. A 984cc air/oil/fan-cooled, fuel-injected 45° V-twin makes 92 hp at 7500 rpm and 70 lb.-ft. of torque at 5500 rpm. The bike rides on 17-in. Pirelli Scorpion Sync tires. The wheels and lower bodywork are black. MSRP is $8695. *Ken Juran*

ASIA SPY REPORT

BY BEN STEWART

Happy Anniversary

LOYAL Z fanatics have been waiting patiently for a higher-horsepower version of the Nissan 350 Z. And rumors of a turbocharged Z have been floating around since the current car was introduced.

MORE UP FRONT: There's no turbo, just more power coming soon.

Well, next year we will get more power—but without a turbo. To celebrate the Z's 35th anniversary, Nissan will launch a 300-hp version. The 13-hp boost comes from subtle engine tuning. The car will wear special 18-in. wheels covering Brembo brakes and carry unique front and rear spoilers. As for the turbo Z, Nissan may choose to scrap the idea because the more expensive 400-plus-horsepower Skyline GT-R, which uses the same chassis as the Z, is scheduled to arrive in 2007. You can expect this Z at dealers in a few months.

Grand Scheme

FOR 2006 Suzuki will introduce an all-new Grand Vitara SUV. Our sources tell us the new model will finally lose its body-on-frame design and move to a unibody chassis. This should help the Grand Vitara compete more directly with less expensive crossovers like the Hyundai Santa Fe. The new Grand Vitara will be larger than the outgoing model, and the standard V6 engine will grow in both size and power over the one in today's truck. The added length of the new SUV may mean the availability of a third row of seats. However, a more likely scenario is that a longer, seven-passenger XL-7 model will fill that niche.

(Please turn to page 62)

GOING MAINSTREAM: Suzuki's Vitara goes unibody and gets bigger.

PHOTO BY HIDDEN IMAGE (SUZUKI GRAND VITARA SUV)

2000
Winston Cup Champion
Bobby Labonte.

2002
Winston Cup Champion
Tony Stewart.

Your results may vary.

www.wixfilters.com

Put a WIX oil filter on your engine and you'll get the same race-inspired technology that helped Joe Gibbs Racing win two Winston Cup Championships. And you'll also benefit from the fact that WIX filters out 45% more dirt and lasts 35% longer than the leading brand. Which is great for your car, but don't expect to bring home any big, national awards. Unless they start giving out trophies for clean engines. **WIX. The #1 Filter in NASCAR.**

NASCAR PERFORMANCE

WIX FILTERS

©2004 GM Corp. All rights reserved. Pontiac® Pontiac logo® G8™

PONTIAC

THE FIRST-EVER
G6
You're cheating on your car just looking at it.
The first-ever G6. Starting at $21,825.* Full details at firsteverg6.com.
*GT as shown $25,425. MSRP. Tax, title, license, dealer fees, and other optional equipment extra.

ACTION

ASIA SPY REPORT

The Big Gets Bigger

LOTSA LENGTH: Next Avalon gets stretched to limolike proportions.

THE developmental engineers for Toyota's all-new flagship sedan, the Avalon, were performing final hot-weather validation when our spies caught up with them. Though the Avalon is cloaked in massive amounts of camouflage, one thing is for certain: This is one very large sedan. The next Avalon could end up being the largest and roomiest front-drive sedan in America. In fact, some have said the rear-seat legroom will be close to that of the Lexus LS 430. The new car rides on a stretched and widened version of the Camry platform. The Camry's 3.3-liter V6 will be enlarged to 3.5 liters. Horsepower for that new motor is said to be hovering around 270. The new Avalon will wear much more stylish sheetmetal, but the deliberate disguise makes it tough to see here.

Sportier, Sexier, Smarter

THE Lexus GS 300 and GS 430 will be replaced in 2006 by this all-new car. Meant to be sportier than the outgoing model, the six-cylinder GS 300 will boast a 245-hp 3.0-liter engine good for 228 lb.-ft. of torque. The new GS 430 will keep the current car's 4.3-liter V8. Both engines will be mated to a six-speed sequential automatic with manual shift controls. The GS 300 will offer all-wheel drive as an option. You can expect the latest technology such as keyless entry, rear-vision camera, an improved stability control system and radar-based collision awareness.

PLUSH PERFORMERS: The '06 Lexus GS gets an even sportier nature.

PHOTOS BY BRENDA PRIDDY (TOYOTA AVALON); DEREK MARSH (LEXUS GS)

EUROPE SPY REPORT

BY MIKE ALLEN

Here Rover, Here Sport

WITH serious dual exhausts, a lowered suspension stance, and fat, aggressive low-profile tires on large wheels, this is not your jungles-of-Borneo Range Rover. Obviously, somebody at Land Rover headquarters figured out that there's a money-toting segment of the public that likes hot roadholding SUVs—vehicles like the Porsche Cayenne and BMW X5. With parent company Ford to supply engines, the Range Rover could become more than the darling of the polo-club circuit.

FIGHTER: A serious on-road Rover.

Pretty Darn Smart

IT looks like we will finally be getting a version of Mercedes's diminutive Smart here in the States. Dubbed the Smart Formore, this is a small SUV, complete with awd, as any self-respecting SUV must be. Due here for the 2007 model year, the Formore probably will have an engine that parent DaimlerChrysler has already certified to meet U.S. emissions standards. The most likely candidate is the Mercedes 2.3-liter Four.

GET SMART: Expect to pay $30K.

It's Been Awhile

ALFA Romeo has not sold cars here for a few years now. That might change in '06 with the new GTV. Available as both Coupe and Spyder, the new car goes on sale in Europe in '05. We may get it a year or so later, hopefully with a V6 and an all-wheel-drive option in addition to the standard front-drive.

THEY'RE BACK: Alfa will try it again.

PHOTOS BY HIDDEN IMAGE (ALFA ROMEO, VW PASSAT); MARTIN PORCHER

Passages

DUE for introduction at the Geneva Motor Show this spring, the sixth-generation VW Passat will first be available as a sedan. A wagon will follow in a few months—and none too soon, as three-quarters of the Passats sold in Europe are wagons. Still a front-driver, the new chassis uses a transverse-engine layout. PM

PASSING THROUGH: New Passat is a sedan and wagon.

PHOTO BY GLENN PAULINA (RANGE ROVER)

©2004 RJRTC

ADDITIVE FREE

Ingredients: Earth, Water and Sun

Winston cigarettes are made with a blend of 100% tobacco – for a naturally smooth taste created by the earth, water and sun. A flavor unmatched by any additive.

ADDITIVE FREE • NATURALLY SMOOTH

LIGHTS BOX: 9 mg. "tar", 0.8 mg. nicotine, BOX: 12 mg. "tar", 1.0 mg. nicotine, av. per cigarette by FTC method. For more product information, visit www.rjrt.com.

No additives in our tobacco does **NOT** mean a safer cigarette.

Winston

LEAVE THE BULL BEHIND

SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.

INSIDEWINSTON.COM

WEBSITE RESTRICTED TO SMOKERS 21+

LEATHERMAN.COM

WHAT DO YOU SEE IN THE NEW LEATHERMAN?

Leatherman's best selling multi-tool just got better. The newly redesigned Leatherman Wave® features larger knife blades with smooth one-handed opening, large and small bit drivers, stronger scissors and tougher pliers. And with all-locking blades and larger wire cutters, the Wave is truly a cut above the rest.

LEATHERMAN®

Now you're ready.™

WISH LIST '05

A smarter ski. A perfect hammer. A sleeker cellphone. And a supercar for the ages. These are some of the things that dreams are made of. Time to stop dreaming. Here are our picks for the gear of the year.

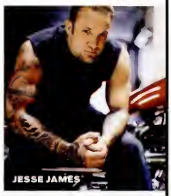
WHEEL CRAZY Not ready to buy a new car? Pimp your ride with **CUSTOM WHEELS AND TIRES** from **TIRE RACK**. Pick from a huge selection of rims and matching tires on the company Web site. Your choices will be mounted, inflated and shipped to your door. Price: from $1000 to over $4000 a set. (Pictured: ASA RT8 rim, $749). www.tirerack.com

PHOTOGRAPHS BY **LUCAS VISSER**

1 WHEEL

D.I.Y. CHOPPER

You can't buy this motorcycle. Like all Long Beach–based West Coast Choppers custom bikes, it was fabricated to a rider's order. You'll need to negotiate for your own model with owner Jesse James (who doubles as the star of Discovery Channel's "Monster Garage"). But you can buy the CFL Basic Frame Kit this chopper is based on. It starts at $2988, though you'll need to add most of the running gear on your own. "It's our basic starter kit that just about anyone can build in their own garage," says Jesse. This design will accommodate a rear tire up to 200mm wide, and



either a chain or belt rear drive. The company can sell you what you need from the West Coast Choppers Web site, including sundries like fenders and seat. "We geared this towards the do-it-yourself mother—" Now, Jesse, that'll be quite enough.

As for the price of a fully built Jesse James custom bike? Highly negotiable, but discussion starts around the window sticker for a nice luxury car. www.westcoastchoppers.com

A COOLER SCOOTER Aside from the girlie-man factor, one thing has kept scooters from catching on in the United States: lack of power. At 469 pounds, the **PIAGGIO X9 EVOLUTION 500** ***($5999)*** claims a top speed of 100 mph, with minimal emissions and fuel consumption, thanks to its 39-hp 460cc engine. And with elegant lines and chrome headlamps, you can hold your head up high as you blow past the neighbors. www.piaggio.com

DREAM MACHINE In the market for a supercar? Probably not. But while you're dreaming, why not dream American? Even in a bumper crop of the best supercars ever built, the **2005 FORD GT** ***($140,000)*** stands out. Built as an homage to Henry Ford II's original 1964 Ford GT40, the new 400-hp GT hits a top speed north of 200 mph; the supercharged V8 goes 0 to 60 in under 4 seconds. The instrument panel features the analog gauges and oversize tachometer of the original. All this for a substantially lower price than the European competition (Porsche, McLaren and the "F" word). www.fordvehicles.com/fordgt/

AIR APPARENT Is it wrong to lust after a tire gauge? In a word: yes. But the **SNAP-ON BLUE POINT DIGITAL TIRE GAUGE** ***($88)*** makes a bit of tool envy understandable. The large backlit digital readout can be seen in the middle of the night, and the flawless construction helps explain why this company's products—which aren't sold in stores—are coveted by mechanics everywhere. www.snapon.com; 262-656-5200.

PHOTOGRAPH BY **ERIC HAMEISTER** (MOTORCYCLE)

2 TECH

SPEAKER OF THE HOUSE For those who can't get enough of that sleek, white iPod aesthetic, the **TIVOLI IPAL TABLETOP RADIO *($129)*** takes its design cues from a higher source. A triumph of form over function? Perhaps not: This portable AM/FM radio delivers solid performance, and also serves as a surprisingly dynamic external mono speaker for any audio source you'd like to play through it (CD player, MP3 player, etc.). The built-in battery offers 16 hours of playing time per charge. www.tivoliaudio.com

GOT THE PLACE? Wear your GPS, don't carry it. At 2.68 ounces (half the weight of most handheld units), **SUUNTO'S X9 GPS WATCH *($699)*** manages to look like a watch, not a computer on your wrist. It stores up to 50 routes and has a built-in altimeter, barometer, compass and thermometer. Direction impaired? Just hit the "Mark Home" button from your starting location, then "Find Home" when you're ready to return. www.suuntowatches.com

LIVING ROOM LIGHT SHOW Just in case video games and DVDs weren't distraction enough, Philips has invented a technology enabling TV viewers to pay even less attention to actual programming. The **PHILIPS 50PF9966 AMBILIGHT PLASMA TV *($7999)*** splashes different-colored lighting from the back of the television onto the wall to match the dominant color on your screen. According to Philips, this boosts the 50-in. TV's onscreen contrast, depth and color for better viewing while keeping eye strain to a minimum. The background lights can be finessed for color choice and brightness, or, thankfully, shut off completely with the remote control. www.usa.philips.com

GET THE PICTURE Digital cameras these days are usually either high-resolution full-size bricks or low-resolution miniature toys. **FUJIFILM** bridges the gap with the ultracompact **F450 DIGITAL CAMERA *($499)***, a sleek 5.2-megapixel model that weighs just 5.3 ounces. Yes, it's really small (2.4 x 3 x .8 in.), but Fuji manages to pack in a 3.4x optical zoom lens and a 2-in. LCD viewfinder on the back. Talent not included. www.fujifilm.com

A SEXIER CELL It isn't easy to get excited by a cellphone these days, but the **MOTOROLA RAZR V3 *($500-$600)*** is capable of turning heads. This streamlined clamshell picture phone is the thinnest on the market (less than 14mm) and is covered in gorgeous anodized aircraft-quality aluminum. The keyboard is chemically etched and created from a single sheet of lightweight nickel-plated copper alloy with a bright blue backlite that illuminates the numbers when you dial. (The phone is just 3.35 ounces.) The built-in camera has a 4x optical zoom if you want to single someone out in a crowded bar. www.motorola.com

Copyrighted material

DESKTOP SAVIOR It has become a tradition: Every few years Apple redefines computer design and creates a high-tech object of desire at the same time. Latest example is the new **APPLE IMAC G5 *($1299-$1899)***, which packs all of its assets, including power supply and disk drive, inside a 2-in.-thick LCD monitor. Aside from its desktop-saving innovations, this baby is all about power: The 64-bit G5 offers processing speeds up to 1.8 GHz and up to 2GB of main memory. www.apple.com

MINI MUSIC FOR THE MASSES The oh-so-cute iPod Mini might get all the attention these days (much of it from giggling teenage girls) but it's not the only diminutive digital audio game in town. The **RIO CARBON *($249)*** is a tiny workhorse with a 5GB hard drive (that's one more gigabyte than the Mini), and 20 hours of music play on a single charge (versus the Mini's 12 hours). Made to play Windows Media files, the Rio is just 3.2 ounces; it holds up to 2500 tunes and adds a built-in voice recorder to boot. www.digitalnetworksna.com/rioaudio

SPIN MASTER It's time to stop suffering through the chick flicks that pass for most in-flight entertainment. Unlike many of its predecessors, the **LG LGDVP7772 PORTABLE DVD PLAYER *($399)*** is so small and light, you won't mind stashing it in your carry-on. With some of the slimmest dimensions in the category (1.1 in. thick x 7.5 in. wide x 6.3 in. high) and a full 7-in. screen, this DVD player stands as a real value. The 4-hour extended battery life will power you through a cross-country "Godfather" marathon. www.lgusa.com

(Please turn to page 72)

WHEN YOUR LIFE CAN BE TAKEN IN A

SPLIT SECOND

YOUR COMMANDS MUST BE TAKEN EVEN FASTER.

Control your elite fighter squadron moment-by-moment using Wingman Command to turn the tides of war.

HTTP://ACECOMBAT5.NAMCO.COM

ACE COMBAT 5
THE UNSUNG WAR

OWN THE SKIES: AVAILABLE NOW

Issue orders and coordinate squadron attacks with split-second precision.

Pilot 50 licensed, authentically detailed planes and choose your aircraft colors.

Engage in an epic story with multiple game modes and unlockable extras.

TEEN
T
Mild Language
Violence
ESRB CONTENT RATING www.esrb.org

PlayStation.2

OFFICIAL GUIDE AVAILABLE FROM BRADYGAMES KEEP YOUR GAME FOCUSED

namco
www.namco.com

ACE COMBAT™ 5 The Unsung War & © 2004 NAMCO LTD. ALL RIGHTS RESERVED. "PlayStation" and the "PS" Family logo are registered trademarks of Sony Computer Entertainment inc. The ratings icon is a registered trademark of the Entertainment Software Association. All trademarks and copyrights associated with the manufacturers, aircraft, models, trade names, brands and visual images depicted in this game are the property of their respective owners, and used with such permissions./Copyright and other rights owned by BAE SYSTEMS PLC and its partners and are not to be reproduced without the prior written consent of BAE SYSTEMS PLC./Produced under license from Boeing Management Company./MIRAGE and RAFALE are aircraft and registered trademarks of DASSAULT AVIATION./Produced in cooperation with Japan Air Self-Defense Force./Lockheed Martin Trademarks used under license to Namco Ltd./Produced under a license from Northrop Grumman Systems Corporation.

3 TOOLS

A HIGHER PLANE Since Roman carpenters first pushed a hand plane, toolmakers have wrestled with ways to make human-powered wood smoothing easier and more precise. That effort has reached a state of near-perfection with the **VERITAS #4 SMOOTH PLANE *($175)***, which provides ultrafine adjustments of its cut. The brass, steel and cast-iron construction gives it Roman-like durability too. www.leevalley.com

JUST SAY CUT We can't promise that the **SEARS CRAFTSMAN PROFESSIONAL 11.5-AMP RECIPROCATING SAW *($199)*** will make demolition even more fun, but it will certainly make it easier. It's the first with a head that pivots 180°, while both blade and handle turn a full 360°. The bottom line: it helps you get into tight places to cut through lumber, plywood, pipe and plaster like a mechanical machete. www.sears.com

MUSCLE MOWER For guys who take their lawns seriously, the **JOHN DEERE X575 *($11,150)*** may be the ultimate four-season yard-care machine. Powered by a 23-hp engine and a hydrostatic transmission, the four-wheel-drive tractor is one of the most powerful machines in its size—and price—class. Weighing in at 955 pounds, it can mow a 5-ft. 2-in. swath of grass, plow copious amounts of snow and till earth in the spring (attachments sold separately). With its power steering, you may want to take it on the road—though at 8.5 mph, you won't get far. www.deere.com

WANNA SPLIT? Great for chopping kindling, lopping off tree limbs and, um, skinning a kill, the versatile **GRANSFORS BRUKS HUNTER'S AXE *($90)*** comes with a hickory handle and a 20-year warranty. Beautifully hand-forged by Swedes who themselves look to be hand-forged, the head of each ax is stamped with the initials of the actual guy who made it. www.gransfors.com

HAMMER OF THE GODS If driving nails makes your arms ache, get to the gym—*now*. But if you have a full day's worth of framing ahead of you, you may want to reach for the **STILETTO TIBONE SOLID TITANIUM HAMMER *($199)***. The combination of the longer, 14-in. length and the superlight weight (a 15-ounce head versus the typical 24-ounce steel version) produces a rapid, high-powered swing with far less fatigue. It's as close to a human-powered nail gun as you'll ever get. www.stilettotools.com

DIRT DEVILS Other than producing a good pint, gardening is one of the things that Brits truly do right. One reason: They've got the right tools. The **SMITH & HAWKEN ENGLISH FORK AND SPADE *($49 AND $55)*** are each crafted from high-carbon steel for strength and durability. Both are 43 in. long and have traditional ash handles set and riveted into extra-long sockets—making them rigid enough to pry up heavy rocks, but elegant and durable enough to last for generations. www.smithandhawken.com

4 PLAY

A SKI FOR ALL SEASONS Why load your closet with skis when you can have one pair that does it all? This multifunctionality has been the holy grail for years, and Atomic may have nailed it with the **ATOMIC METRON M:EX PULS-TI SKIS *($799)***. It has the deep sidecut you'd expect in a carving ski, but it's every bit as adept in the deep powder of the West as it is cutting grooves on the hardpack of the East. What sets this ski apart is a core construction made from hollow magnesium tubes; stronger and lighter than aluminum, these "power channels" provide plenty of grip and spring. And a titanium topsheet gives some dampening to ensure a smooth ride. www.atomicski.com

COOL RUNNING No, wearing **AIR ZOOM VICK II CROSS-TRAINERS *($120)*** won't give you the athletic ability of one of the NFL's hottest quarterbacks. Next question? These sneakers, named for Atlanta Falcons superstar Michael Vick, are packed with technical features to boost speed and agility (and justify their high cost). A new adjustable heel-fit system helps lock in the foot and provide greater lateral support during high-intensity workouts, as does the Caged Zoom Air cushioning unit. A venting system keeps the foot cool, and a new tread pattern provides extra traction on a variety of surfaces. They look pretty good too. www.nikegridiron.com

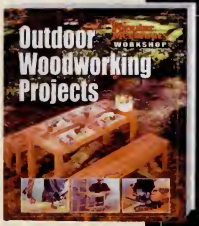
TINY TRACKER No need to break the bank on a new global positioning system unit—the **MAGELLAN EXPLORIST 100 *($99)*** is the first GPS handheld under $100 that can pinpoint a position within 10 ft. Bound in a bright orange waterproof rubber case, it has a large 2.3-in. grayscale display and can store up to 20 routes. And at only 4 ounces, you can slip it into your jacket pocket and forget about it. Until you need it, that is. www.magellangps.com

(Please turn to page 76)

Popular Mechanics WORKSHOP

BUILT WITH PRIDE

BOOKS WITH PRACTICAL, HIGH-QUALITY CARPENTRY PROJECTS



POPULAR MECHANICS WORKSHOP

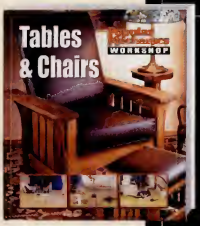
OUTDOOR WOODWORKING PROJECTS

Great carpentry looks even better in the yard than it does in the living room. Bring your talents out into the fresh air with 23 handsome projects including: storage shed • redwood deck with benches • porch swing • Adirondack chair • picket fence • garden cart • and more.

POPULAR MECHANICS WORKSHOP

SHELVING & STORAGE

You'll never trip over a pile of accumulated "treasure," or struggle to open an overstuffed drawer again with these 30 practical, fabulous-looking storage projects: five-drawer cherry dresser • kids' computer desk • pickled poplar wardrobe • magazine rack • baking cart • toolbox • and more.



POPULAR MECHANICS WORKSHOP

TABLES & CHAIRS

Next time you pull up a chair, make it one you can sit in with pride. Select from 30 sturdy, classically designed furniture projects: Craftsman-style rocker • Chippendale dining chair • mud room bench • oak dining table • sideboard with doors • cherry gateleg table • and more.

All projects illustrated with detailed diagrams and color photos.

Each book only $19.95 (Canada $29.95) in paperback wherever books are sold.
HEARST BOOKS

CORE VALUES BURTON'S T6 SNOWBOARD *($649)* Is great for hitting just about anything but the rails. Intended for freestyle riding, this signature board of pro superstar rider Terje Haakonsen is actually one of the most versatile models around, thanks in part to something called "Alumafly" technology. Resembling the kind of aluminum honeycombs used in fighter jet frames and helicopter blades, the core of the board is 90 percent air. Result: extra flex and durability compared to the usual wood core. www.burton.com

SPY CRAFT Watching football games from the nosebleed seats, hunting, everyday voyeurism—these are activities that demand a good pair of binoculars. And now, with the **BRUNTON XC8 *($629)*** XC8 glasses, you won't have to lug around a big, heavy piece of equipment. The company's first compact, full-featured field glasses, the 13-ounce XC8s have been nitrogen purged to make them waterproof, and they offer 8 x 21 magnification. www.brunton.com

DRIVING IN STYLE Not long ago, the makers of high-tech golf drivers forced players to choose between power or control. Now TaylorMade adds a third option: flexibility. The **TAYLORMADE R7 QUAD DRIVER *($599)*** has a proprietary "Launch Control" technology that lets you redistribute 24 grams of weight using four cartridges plugged into four ports located inside the club's head. The result: a customized swing. Mix and match the different weights to alter the titanium club's center of gravity for six different ways to drive the ball. Soon, you'll have more time to enjoy that Thermos of Bloody Marys while your opponents chase their drives into the woods. www.taylormadegolf.com

(Please turn to page 78)

"ONE OF THE SCARIEST GAMES EVER MADE."

-THE ASSOCIATED PRESS

★★★★★

"TOO LIFELIKE FOR COMFORT."
- TIME MAGAZINE

"ELEVATES GAMING AS AN ART FORM."
- COMPUTER GAMING WORLD

"SUPREMELY ENTERTAINING AND REPRESENTS A MASSIVE TECHNOLOGICAL LEAP."
- MAXIMUM PC

"ONE OF THE MOST IMMERSIVE GAMES THE INDUSTRY HAS SEEN"
- CNN.COM

"THE PERFECT ALONE-IN-THE-DARK NIGHTMARE."
- ROLLING STONE

"A VISUAL MASTERPIECE."
- PC MAGAZINE

THE MOST FRIGHTENING AND GRIPPING FIRST-PERSON PC GAMING EXPERIENCE EVER CREATED IS NOW AVAILABLE.

MATURE 17+
M
ESRB
Blood and Gore
Intense Violence

Distributed By
ACTIVISION.

Developed By
id
idSoftware.com

DOOM 3™

DEMO AT WWW.DOOM3.COM

©2004 Id Software, Inc. All rights reserved.

SMOOTH RIDER Until recently, there were two main types of mountain bikes: racy models built for speed, and beefier designs meant for big drops and boulder bouncing. Specialized hits the sweet spot between those extremes with the **SPECIALIZED FSR XC *($1100)***. It's a full-suspension aluminum bike that's light enough (30.5 pounds) to ride all day, and has front and rear shocks, both delivering 4 in. of travel, that are tough enough to soak up the big hits. All this for just over a grand. www.specialized.com

GHOULISH GAMING Miss playing with your Jabba the Hut and Transformer action figures? Relive those cherished memories with the **GEMINI FREAK SERIES BERSERKER GAME CONTROL PAD *($25 FOR PS2)***. It's an action toy! It's a full-featured game controller! It's both! So why not add a little more fun to your fun? If this doesn't get you a date, nothing will. www.gemini-usa.com

SEQUEL MANIA! The big business in video games, just as it is in Hollywood, is now in sequels. **GRAND THEFT AUTO: SAN ANDREAS *($50, PLAYSTATION 2; WWW.ROCKSTARGAMES.COM)*** is Rockstar Games' third incarnation of its best-selling ultra-violent crime series; this West Coast version lets players pillage and plunder through three different sun-drenched landscapes. For those looking for more cerebral pursuits, **UBISOFT'S CHESSMASTER 10TH EDITION *($40, PC; WWW.CHESSMASTER.COM)*** adds 3D graphics and an improved artificial intelligence engine to the industry's best chess simulator. **PM**

Think of them as a reprieve from the world around you. Whether it's the engine roar on airplanes, noise of the city, bustle in the office or the blare of neighborhood yard work, these headphones help you escape them all. And they do it with the flick of a switch. You savor delicate musical nuances in places where you couldn't before. And when you're not listening to music, you can use them to quietly enjoy a little peace. Clearly, Bose QuietComfort® 2 headphones are no ordinary headphones. It's no exaggeration to say they're one of those things you have to experience to believe.

Reduce noise with Bose technology. David Carnoy reports on *CNET* that our original noise-reducing headphones "set the gold standard." And according to respected columnist Rich Warren, our newest headphones "improve on perfection." They electronically identify and reduce noise while faithfully preserving the music, movie dialogue or tranquility that you desire. As Jonathan Takiff reports in the *Philadelphia Daily News*, "Even in the noisiest environment, wearing these phones creates a calming, quiet zone for easy listening or just snoozing."

Use them as a concert hall – or a sanctuary.

Presenting The Bose® QuietComfort® 2 Acoustic Noise Cancelling® Headphones.

Enjoy your music with our best headphone sound quality ever. After trying QuietComfort® 2 headphones, audio critic Wayne Thompson reports that "Bose engineers have made major improvements." The sound is so clear, you may find yourself discovering new subtleties in your music. *CNET* says "All sorts of music – classical, rock, and jazz – sounded refined and natural."

"The QuietComfort 2 lives up to its name, enveloping you in blissful sound in the utmost comfort. It's easy to forget they're on your head." That's what columnist Rich Warren says. And as Ivan Berger reports in *The New York Times*, the "QuietComfort 2 offers more conveniences than the original model." You can wear them without the audio cord to reduce noise. Or, attach the cord and connect them to a portable CD/DVD/MP3 player, home stereo, computer or in-flight entertainment system. When you're done, their convenient fold-flat design allows for easy storage in the slim carrying case.

Try the QuietComfort® 2 headphones for yourself risk free. We don't expect you to take our word for how dramatically these headphones reduce noise, how great they sound and how comfortable they feel. You really must experience them to believe it. Call toll free to try them for 30 days on your next trip, in your home or at the office – satisfaction guaranteed. If you aren't delighted, simply return them for a full refund.

Call 1-800-720-2673, ext. Q3416 today. These headphones are available directly from Bose – the most respected name in sound. Order now and you'll receive a free portable Bose CD Player with skip protection – a $50 value. Be sure to ask about our financing options. So call and discover a very different kind of headphone – Bose QuietComfort® 2 Acoustic Noise Cancelling headphones.

FREE Bose CD Player when you order by Jan. 31, 2005.

1-800-720-2673, ext. Q3416

For information on all our products:
www.bose.com/q3416

*Name*_____
*Address*_____
*City*_____ *State*_____ *Zip*_____
*Day Phone*_____ *Eve. Phone*_____
*E-mail (Optional)*_____

Mail to: Bose Corporation, Dept. DMG-Q3416,
The Mountain, Framingham, MA 01701-9168

BOSE®
Better sound through research®

©2004 Bose Corporation. Patent rights issued and/or pending. Financing and free CD Player offer not to be combined with any other offers or applied to previous purchases, and subject to change without notice. If QuietComfort® 2 headphones are returned, CD Player must be returned for a full refund. Risk free refers to 30-day trial only. Delivery is subject to product availability. Quotes are reprinted with permission: David Carnoy, *CNET*, 5/29/02, Rich Warren, *News-Gazette*, 5/19/03, Jonathan Takiff, *Philadelphia Daily News*, 5/29/03, Wayne Thompson, *Dragonwar*, 4/18/02, Ivan Berger, *The New York Times*, 5/1/03.

SPEED: **252 mph** | ALTITUDE: **20 ft.** | MARGIN OF

FLYING'S NEW SCHOOL: The organizers of Aerobatic air racing have melded the intricate maneuvers of aerial acrobatics with the speed demands of NASCAR.

ERROR: o FLYING ON THE KNIFE-EDGE

Welcome to the scary new sport of aerobatic air racing.

BY ROBERT EARLE HOWELLS

PHOTOGRAPHY BY PATRICK FRASER

A GLINTING BLUE SPECK of airplane comes roaring out of the western sky and then dives toward the ground at a jaw-droppingly way-too-steep rate of descent. It whirs past 40,000 sets of astonished eyeballs at 252 mph—just 20 ft. off the deck—then seems to jam on the brakes in midair as it banks to the right in an insanely tight U-turn, aiming directly for the open space between two pylons that stand only about 60 ft. high—and much too close together. *Are they even a wingspan apart? How the hell is he going to clear ...* It happens too fast to phrase the question, because the pilot has already leveled his wings and shot through that gate and then another, and you swear you feel the force of gravity smashing *your* head against the back of *your* seat as he pulls another impossibly tight turn—11 g's!—while an announcer imported from the X Games yells "He-e-e's rippin' it!" at a crowd that needs

no exhortation. The Red Bull Air Race is on.

So it went on a Saturday in September at Nevada's Reno National Championship Air Races, an event that draws throngs of flight buffs and aeronautics nostalgists. Normally, they sit back and watch vintage planes fly long, polite ovals in races that permit ample time for yawning. I sat in the middle of the bleachers to watch the Red Bull event, where the reaction was electric—like imbibing high-octane shots of terror, amazement and admiration for the pilots who brought this kind of racing to U.S. airspace for the first time.

IT'S SAFE. NO, REALLY

The sport is called aerobatic air racing. In a solo race against the clock, each pilot flies his single-engine, prop-driven plane around a tight slalom course marked by five sets of inflatable pylons, with a measly 40 to 46 ft. of blue sky between each. (Typical wingspan: just under 25 ft.) That alone requires supreme stick-and-rudder prowess. But the race also mandates aerobatic maneuvers such as vertical rolls, a high-speed touch-and-go landing on a 12 x 36-ft. spot that looks like a postage stamp from the sky, and harrowing knife-edge passes through two sets of gates—that is, with wings perpendicular to the ground. The sequence for that portion is: Knife-edge right ... wings level ... quick right turn to set up for the next gate ... wings level again ... knife-edge left—with the wingtip maybe 10 ft. off the ground. It takes about 2 seconds.

Veteran aerobatic pilot Peter Besenyei, 48, of Hungary, concocted the event ("Aerobatics needed some excitement," he says), and Red Bull, the energy drink company, signed on to sponsor it in Europe in 2003. This year the company pumped up the hype potential by adding an international championship: Winners of the year's two European races would square off against a U.S. national champion for the title of world champion. It was the U.S. championship that blew away the Reno crowd on that Saturday in September; the international championship followed the next day.

Improbably, as gonzo as they appear, the aerial acrobatics in the Red Bull race are actually fairly routine for topnotch aerobatic pilots. Kirby Chambliss, 45, who won both races in Europe this year, is a four-time U.S. National Aerobatics Champion and has been loop-dee-looping since 1988. He flies far more challenging routines in exhibitions (including an infamous inverted ribbon-cutting stunt) and competition aerobatics. But those events are somewhat analogous to sky-high figure skating: The planes fly high enough to provide a big safety cushion, for one thing, and winners are determined, Olympic style, by fussy judges. No one's running a stopwatch.

Adding the dimension of the clock and the pylons makes it a brand-new game. "In competition aerobatics, we have a bottom line of 328 ft.," says Chambliss. "In a Red Bull Air Race you're running 10, 20, 30 ft. off the ground and pulling very high g's around these obstacles."

This fast-twitch spin on traditional aerobatics raises a natural question, one that must have occurred to the marketing gurus at Red Bull: What if someone gets killed out there? The sponsors, who not only care about safety but also have hard-won brand equity to think about, are quick to explain that *everything is just fine*. The first line of defense against disaster is an exclusive guest list: Only a dozen pilots have been invited to compete so far. "Everyone out there is a national or international champion in aerobatics," says spokesperson Steve Pegram. As an added protective measure, the pylons are intentionally flimsy—the worst consequence of hitting one is a deflated pylon. The pilot flies on; the ground crew inflates a new pylon.

"It's all intermediate-level aerobatics," says Tim Brill, who runs an aerobatics flight school in Reno, and was out to watch the races. "These guys are trained to do hair-raising stunts at low altitude." Surprisingly—at least to the uninitiated—the most dangerous part may be the touch-and-go landing. "I call it the crash-and-go," says Brill. "You're doing all these rolls and maneuvers and suddenly you have to focus on putting the plane down. It's real easy for something to go wrong, for a wing to hit the ground. We don't even teach it in aerobatics school."

THE ASTOUNDING G-MAN

I spent a long weekend at Chambliss's Arizona home watching him fly a course several dozen times during the filming of an interactive feature for a Red Bull Web site (www.redbullcopilot.com). Finally, after the gravy train's

CEILING UNLIMITED: Pilots at the first U.S. championship of aerobatic racing competed on a five-gate course, combining hairpin turns with mandatory tricks—including the vertical roll shown here.

PHOTO COURTESY OF RED BULL

Ultimate Machine

Like a gymnast, an aerobatic aircraft packs maximum power into the lightest, most agile package possible. The Zivko Edge 540, pictured here, represents the state of the art.

CHAMPION PILOT
Kirby Chambliss: age, 45; height, 6 ft. 2 in.; weight, 200 lb. Credential: Reigning U.S. Aerobatic Champion. Max g-force tolerance: 11-plus.

SINGLE ENGINE
The plane's stock Lycoming 10-540 engine turns out 330 hp and 750 lb.-ft. of torque.

LIGHT, RIGID FUSELAGE
The Edge 540's body is a steel-tube design with composite fairings. It can withstand more than 15 g's of sustained loading.

CARBON-FIBER WINGS
Symmetrical high-lift wings allow conventional and inverted flying. The wings are oversize relative to the weight of the aircraft.

film crew parted with their feature in the can, I bummed a no-witnesses thrill ride in a two-seat Zivko Edge 540T. Chambliss handed me a clear plastic bag ("so everyone can see what you had for lunch") and tutored me in a maneuver to avert g-lock (basically, forcing blood to the brain as if deliberately making your face turn red). Otherwise I'd enjoy the first turn, then quietly black out for the duration of the ride.

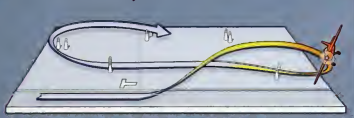
After a few easy loops to test my inclination to hurl—so far, so good—he ran me through the course. The sensation was both thrilling and violent. He took no turn harder than 5 g's (we ran the course in about 3 minutes, or a third slower than Chambliss had been taking it solo), yet while I dutifully braced myself to keep blood in my brain, I felt like Shrek had leaped onto my lap, while a second beast was pulling the flesh off my face from behind. I couldn't move my hands. My legs cramped. As the horizon shifted constantly, Chambliss called the play-by-play: "Look right. Look left. Now it's gonna be on top." He explained: "I always look at the ground. It's what you don't want to hit."

After 20 minutes of loops and rolls, I felt like I'd been on the wrong end of a meat tenderizer, and my stomach seemed to have landed in an unaccustomed location. When Chambliss suggested an end-over-end tumble from the sky, I requested a nice soft landing instead.

Fortunately for aerobatic pilots, it's possible to build up a tolerance to g-forces. Chambliss has a hangar just off the den of his home and a runway right outside. He rolls out of bed nearly every morning to fly in his backyard. "Pulling 10 g's makes you feel like you weigh 10 times your body weight," says Chambliss, "and all the blood in your brain wants to end up down in the trunk of your body. When that happens, you lose consciousness." Negative g's (pushing down rather than pulling up, or flying inverted, forces

Flying's Eye-Popping New Race

1 HARD RIGHT TURN



Racers started the first of three laps on the course in Reno, Nev., basically going the wrong way. The first right turn was a make-or-break move. "You pull about 9 or 10 g's," says Mike Mangold, the race's eventual winner. As soon as they finished the turn, competitors rolled their wings level with just enough time to get through the gate.

2 FULL ROLL

The full roll, which came about halfway through the race, required pilots to point the nose to the sky and do a complete rotation before diving straight towards the ground at over 200 mph. The pilots pulled up at the last second, resisting high g's that forced them into their seats, and quickly set up for the next gate—before entering another tight turn.

3 TOUCH-AND-GO

The two-of-four roll required two quarter-turns while aimed straight up. The pilots then sideslipped down at a tremendous speed, using drag on the fuselage as a brake. Next came a rapid (and dangerous) touch-and-go maneuver—the pilots touched down in a narrow strip and immediately became airborne again. "You're putting the airplane down rather abruptly," Mangold notes dryly.

4 ELAPSED TIME: 1:54:12

Mangold, an American Airlines pilot, says his years flying F-4s in the Air Force helped him find the fastest line through the course and take both the U.S. championship held Sept. 18, and the international competition the next day (when he smoked the field in 1:54:84).

ILLUSTRATIONS BY MARK BRENNER

PORTRAIT COURTESY OF RED BULL

blood to the brain) have their charms too. Broken blood vessels in the face that pilots call g measles. The risk of a detached retina or an aneurysm. But Chambliss, according to friend and fellow pilot Jeff Mawhinney, is a "g monster." He can pull 10 g's or more consistently—and he can push big negative g's—with little apparent effect on his body. Chambliss says it's all about flying. A lot. He told me matter-of-factly that he has probably logged 1000 hours—*flying upside down*. "But if I don't fly for two weeks, I feel like I'm starting over."

While many aerobatic pilots earn their wings in the military, Chambliss followed a civilian route. The son of a sky diving instructor, he was something of a runway rat growing up in Corpus Christi, Texas. He soloed at 17, started flying commercially at 21, and at 28 became Southwest Airlines' youngest captain.

That's about the time Chambliss started flying aerobatics. Since then, he has won world championships in addition to his four national titles. He still flies several days a month for Southwest—dutifully keeping the airliner right side up. And he's the test pilot of choice for Oklahoma-based Zivko Aeronautics, the maker of the Zivko Edge 540 airplane that Chambliss and both his chief competitors were flying in Reno.

"KIRBY CHAMBLISS SAYS THAT HE HAS PROBABLY LOGGED 1000 HOURS—FLYING UPSIDE DOWN."

UNDER WRAPS: Aerobatic air racing, launched in Europe, debuted to U.S. spectators in September.

FAST FORWARD

The Edge 540 is an astoundingly maneuverable plane developed especially for aerobatics. The plane handles quicker and can pull more g's than an F-16. With carbon-fiber wings and a welded steel fuselage, the Edge 540 weighs a feathery 1175 pounds. Mate that with a stock 330-hp Lycoming engine and you have the highest thrust-to-weight ratio of any aerobatic plane in the sky. Maneuverable? Its stated roll rate is 420° a second. In real life, says Chambliss, it's more like 500°. In other words, an expert pilot can roll the Edge 1½ times in just over a second. While that agility has always been critical to aerobatic pilots, speed never mattered much. In an aerobatics competition, explains Chambliss, "you're in a 3300-ft. box. The faster you go, the more g's you have to pull to stay in the box. Judges are watching your crispness, your snaps, not your speed." That, of course, has changed with the advent of aerobatic air racing.

After winning the season's first competition in England and then taking first place again in Budapest (in a race that required pilots to fly underneath a Danube River bridge), Chambliss came into Reno as the favorite to win the U.S. premiere of the Red Bull Air Race. However, first-time Red Bull racer Mike Mangold, 49, of Victorville, Calif., emerged as the fastest pilot during the qualifying heats that whittled a field of eight down to four. Mangold, who flies B-767s for American Airlines, carries an Air Force Academy pedigree; he flew F-4s for 10 years and graduated from the "Top Gun" school as the No. 1 pilot in 1984. Peter Besenyei, the Hungarian who created the event, was also a finalist, along with U.S. pilot Mike Goulian, 36.

Chambliss kicked off the national finals and impressed everyone with a time of 2:03.04, but eventually Mangold found the fastest line through the pylons and beat the competition in 1:54.12. He repeated his victory on the same course the next day to capture the sport's first international championship.

The score box didn't matter much to the air show fans—who until that day probably hadn't heard of the sport, let alone the pilots. The spectators were as docile as a lawn-bowling audience until the aerobatic race commenced, then quickly went nuts. The blend of tremendous speed, high g's, and stunning maneuvers that brought them from stupor to frenzy will only intensify if the sport thrives.

As many as seven competitions are planned for next year. While the format seems unlikely to change dramatically, the planes will undoubtedly get better—which is to say, faster. Already, Mangold's Zivko has a superior exhaust system that gives him an extra 5 or 10 hp. That margin may not have meant much during the race, but "as this event blossoms," says Mangold, "greater minds than mine will find ways for us to go faster." Chambliss predicts that one day soon ground crews will start tweaking the machines between heats, just like NASCAR pit crews do today.

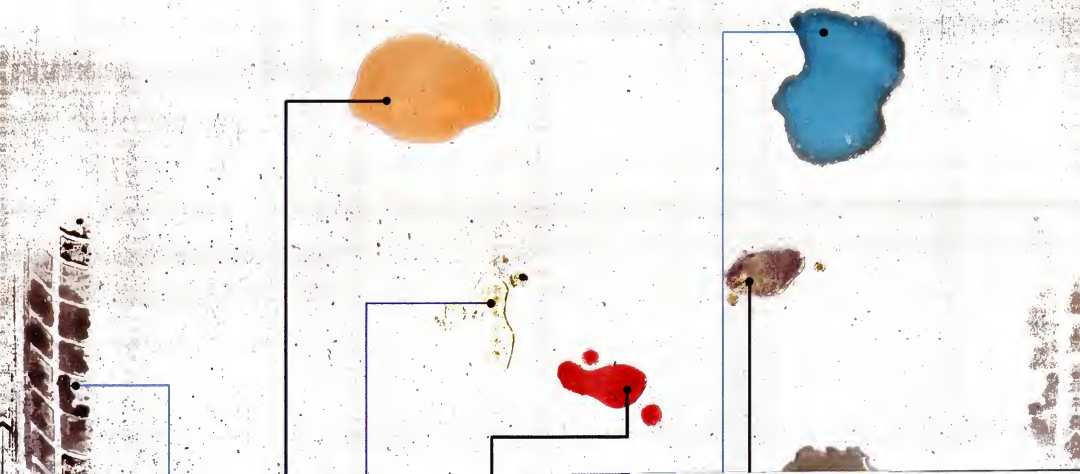
Soon after the final race in Reno, Chambliss stood looking up at an F-15 formation flying by overhead. He never cared much about going fast, he shouted over the roar of the jets. "Now," he continued, "I'm thinking differently." PM

For more outdoors features check out the PM.Zone Web site
@ POPULARMECHANICS.COM/OUTDOORS

Popular Mechanics

GRIME SCENE INVESTIGATION

(solving the mystery of your garage floor)



brake fluid

Brake fluid, which has a sort of soapy feel, is completely colorless and odorless when new. As it ages, it turns a smoky gray due to contaminants from rubber seals and rubber-lined brake hoses. It can leak from a failed brake line or a caliper, and then you'll probably see it on the inside of the wheel. It eventually evaporates, leaving little trace behind.

coolant

Coolant has tra-ditionally been an unmistakable fluorescent lime green. But now we have red and orange coolant, depending on the vehicle. Coolant loses some of its bright color as it ages, but will remain visibly green, red or orange. All coolant has a characteristically sweet odor, particularly when it drips onto hot metal. Combine a very hot day and a hot car, and there may be a spoonful or so burped out of the overflow onto the ground. Coolant is toxic, so don't let the kids or a pet ingest any.

atf

Automatic trans-mission fluid is almost always a vivid red when it's new. It gradually gets brown and cloudy, looking more like used oil or gear lube.

gear lube

It is oily and viscous, like motor oil. Gear lube has a distinctive sulfury smell you'll readily recognize when you sniff your finger. To complicate matters, some manual transmissions are filled with motor oil or ATF, instead.

windshield washer fluid

In the jug it's as blue as Paul Newman's eyes, but it soon fades to clear water on concrete. Unlike water, it has a soapy feel and an alcoholic smell—it's about half alcohol. It may leak at any point under areas where the washer hoses run—or anywhere along the length of a vehicle that has a rear-window washer system. It's toxic, so keep Bowser and Junior away.

oil

Motor oil normally will be found leaking below the centerline of the car on rwd vehicles and from the engine side of the engine compartment on fwd cars. It gets brown or black within a few hundred miles of being changed. It's normally viscous enough to leave a puddle that doesn't creep, even if the leak is big. It has some odor, and is very, well, oily to the touch. Oil leaking from a valve cover gasket may drip onto the exhaust manifold, creating a burning smell.

h_2o

Yup, plain 'ol water that your air conditioner extracts from the humidity in outside air drains down to the ground through a hose just ahead of the firewall—near the passenger's feet. This water is normal and expected. If this drain plugs up, you'll get water *on* the passenger's feet.

You've got a new stain

BY MIKE ALLEN

PHOTOGRAPHY BY MICHAEL HEIKO

on your garage floor, smack in the middle of where your car is usually parked overnight. Aside from the aesthetic, there's the danger of running your engine out of oil or coolant, or worse yet, brake fluid. You don't need to be a forensic specialist to figure out what that funny-smelling stuff is under your car, but you might need to get down on your hands and knees to examine, touch and even sniff the offending fluid up close. Once you've identified the leaking fluid, you'll want to fix the source of the leak.

CLEANUP ON AISLE 3

Now you've got your leak pinpointed and repaired, but the memory—and the stain—linger on. To get rid of the stain, mix a double handful of kitty litter and a quarter-cup of laundry detergent in some sort of container, adding enough water to make the resulting slurry the consistency of gravy. Cover the stain with this slurry. Allow it to dry thoroughly, then sweep it up.

Courage After Fire

Guardsman ***Kevin Pannell*** was on a routine foot patrol in Baghdad when an insurgent's grenade tore apart his world. After enduring 13 operations the young soldier from Arkansas now begins his next epic battle: learning to walk all over again.

by Leslie Sabbagh

photography by Yunghi Kim

FIRST STEPS: Under the watchful eyes of therapists at Walter Reed Army Medical Center, Spc. Kevin Pannell tries out a C-leg, the first computerized artificial limb.

JOHN DEER

ALONG THE PERIMETER

of a physical therapy clinic the size of a basketball court, a man moves slowly, relentlessly, one rocking step at a time. His concentration is ferocious: Push the walker; hop-step on the left prosthesis; swing the right leg, gone from the knee down; push the walker. It's draining work: Sweat streams down the man's face; he's breathing hard. A physical therapist pushing a black wheelchair walks alongside him; a prosthetist scrutinizes every movement. Specialist Kevin Pannell, a 26-year-old National Guardsman from Arkansas with the 1st Battalion, 9th Cavalry Regiment, is using his new left leg for the first time.

He forces himself to keep going around the perimeter of the room—80, 90, 100 ft. The physical therapist finally has to end the test run. "That's enough for today, Kevin," she says. Pannell looks up, his face white against his tanned neck, his eyes squinting from the stinging sweat. "I'm good," he protests. "I can go more." But his therapist and prosthetist overrule him, and Pannell settles reluctantly into his wheelchair.

In June, Pannell returned from Baghdad with grievous wounds. Like more than 800 other American combat casualties from Iraq and Afghanistan, he was eventually brought to the Walter Reed Army Medical Center, a sprawling, 112-acre complex at the northern edge of Washington, D.C. Opened in 1909, Walter Reed is the U.S. Army's premier medical facility and is now a world leader in prosthesis rehabilitation. It is here that Pannell is attempting to regain some of the mobility and independence he lost in a Baghdad alley.

The campaigns in Iraq and Afghanistan have tested military medicine as nothing that came before. The wounds of these wars—and the wounded themselves—are unique. Combat casualties who would have died in earlier conflicts are surviving, thanks to reinforced Kevlar vests and helmets, and advances in lifesaving battlefield and post-combat treatment. But the price of survival is often the loss of limbs.

In response, military doctors are developing new procedures to manage combat blast injuries, while aggressive physical and occupational therapies rehabilitate amputees at Walter Reed with unprecedented speed. The center's staff expects the young specialist from Arkansas to be released from the hospital in early January, just seven months after he was wounded. "The number of amputees coming out of combat operations in Iraq and Afghanistan, and their complex medical challenges, led us to develop an amputee patient care center here at Walter Reed," says Maj. Gen. Kenneth L. Farmer Jr., commander of the facility. "We have brought together not only the various medical, surgical, and behavioral health disciplines, but also social support, amputee peer mentors, and partnerships with leading prosthetic research and production players from the civilian sector." To Pannell what's vital is the Walter Reed staff. "It's personal for them. You've been wearing the same uniform that they've got on. It feels like your brothers and sisters are taking care of you."

BIONIC MAN: Dennis Clark, owner of an Iowa orthotics and prosthetics company, tweaks Pannell's C-leg. Clark calibrates artificial limbs hundreds of times as amputees learn to walk again.

EVERY WEDNESDAY Pannell wheels into Spc. Harvey Naranjo's occupational therapy department. And every Wednesday Naranjo, who calls himself Pannell's "occupational terrorist," thrusts out his hand, palm up. Pannell fishes a couple of cigarettes from his pack of Pall Malls and hands them over. Neither man says a word, but both parties understand the significance of the

HEARTS AND MINDS: Armed—and armored—Pannell patrolled a busy Baghdad street the day before he was wounded in another part of the city.

ritual: For the next 90 minutes Naranjo will rule Pannell's world.

"Harvey really wraps himself around his patients," Pannell says. "He even comes to physical therapy sometimes to watch me walk. It's almost like he's raising a kid."

At the weekly sessions Naranjo carefully tends to what's left of Pannell's legs. Like those of most amputees, Pannell's lower extremities are always swollen, so Naranjo has to perform edema massage to push the fluids that collect at the end of the legs up and out. "I have to make sure you have a sexy limb," he teases Pannell as he kneads the soldier's stumps. "It has to fit your socket."

So he wraps and massages, constantly sculpting the residual limbs. To work effectively with a prosthesis, the stump must be conical, thin at its distal end and wider higher up to distribute weight evenly. There must be no pockets where debris can collect; the skin must be smooth and nonirritated. Pannell must frequently bend his right knee so that it remains flexible.

When Pannell first came to Naranjo he had massive soft-tissue damage and an enormous amount of shrapnel embedded in his arms, legs and buttocks. Retained shrapnel is a nasty, lingering complication of blast trauma: Military doctors call it "peppering." Dirt, stones and other debris slice deep into skin and muscle, causing infection, swelling and necrosis. Throughout the day Pannell rubs at the mottled skin on his arms and legs where hundreds of bits of debris scratch their way out. He'll have to deal with emerging shrapnel for the rest of his life.

The occupational therapy department houses an Activities of Daily Life room. It's entered through a screened metal door that leads to what looks like a middle-class apartment with a small living room, a bedroom, kitchen and laundry. The patients call this simulation area Fort Independence. Pannell is in the living room, repeatedly hoisting himself from the floor to the sofa. He's not wearing his prosthesis. His wife, Amanda, chases the couple's 3-year-old son, Hunter, around the suite, trying to keep him under control. A confident boy with a shock of light brown hair and luxuriantly long eyelashes, Hunter just wants in on the fun of scooting around on the floor. But what is play to a child is hard work for Pannell. He climbs into his wheelchair and rolls into the bedroom, where he struggles to climb onto a bed with a slippery spread.

Combat Zone Rx

For soldiers wounded in Iraq and elsewhere, the first 30 minutes are critical: It's when 80 percent of all battlefield deaths occur. In the next few years, front-line medics will be able to employ the following cutting-edge technologies.

BLOOD WORK

Problem: Blood loss accounts for nearly half of all combat deaths.
Solution: San Diego–based Sangart has developed a blood substitute called MP4, which is more effective than human blood in delivering oxygen through the constricted vascular systems of people in shock. And it can be used with any blood type, which means battlefield medics can make immediate transfusions without risking a potentially fatal mismatch.
Estimated deployment: 2007.

PAIN RELIEF

Problem: The primary battlefield painkiller is an intramuscular injection of morphine, which can take up to 20 minutes to kick in.
Solution 1: Innovative Drug Delivery Systems (IDDS) of New York is working on a fast-acting, nonopiate ketamine nasal spray that will enable soldiers to self-manage pain.
Estimated deployment: Late 2006.
Solution 2: RInat Neuroscience of Palo Alto, Calif., has developed a pain antibody called RI 624 to be administered

on the battlefield, or even before combat, to block the effects of a neuropeptide that causes pain. RI 624 could immunize soldiers for up to a week.
Estimated deployment: 2010.

BURN UNIT

Problem: Stopping internal bleeding.
Solution: Therus of Seattle is developing a portable High Intensity Focused Ultrasound device that uses Doppler ultrasound imaging to locate hidden leaks, and a concentric array of ultrasound waves to cauterize wounds in about 10 seconds, without damaging surrounding tissue.
Estimated deployment: 2009.

—*Mike Fillon*

PHOTOS BY LUCIAN READ/WORLD PICTURE NEWS (BOTTOM); COURTESY OF KEVIN PANNELL (TOP)

Next Step

The latest artificial limbs incorporate electronics, high-tech materials, and sophisticated engineering to help amputees lead full, active lives.

RHEO KNEE SYSTEM

Hydraulic knees can sometimes generate excessive resistance when the user makes quick extensions—for instance, when walking briskly. MIT biomechatronics expert Hugh Herr designed a knee with variable support to cover all bases. When the user is standing still, an electromagnet creates a magnetic field in the artificial knee, which contains hydraulic fluid infused with iron particles. The magnetized particles generate resistance, thus stiffening the joint.

BIONIC KNEE

The Bionic Knee, from the Canadian firm Victhom Human Bionics, is the first prosthesis with electric motors to power the knee. Sensors in the shoe worn on the foot of the user's non-amputated leg send signals to the bionic leg's microprocessor, which uses an algorithm to mimic the wearer's natural gait.

BOSTON DIGITAL ARM SYSTEM

Researchers at the Rehabilitative Institute of Chicago have developed a procedure in which surgeons graft existing nerve endings from the shoulder onto pectoral muscles of an arm amputee. When the brain sends a signal to move the missing arm, the message is rerouted to the grafted nerves, which then transmit the impulse via sensors to the Boston Digital Arm System.

SENSOR HAND

This appendage from German health-care giant Otto Bock features shear-force sensors in the thumb to detect when an object is slipping from the hand's grasp. The hand then automatically grips more tightly. The latest model moves its fingers twice as fast as competing designs—up to almost a foot a second—and comes with a quick-release function.

—*M.F.*

Pannell was born in Nashville, Ark., and raised in nearby Dierks, a community of 1200 in the southwestern corner of the state. His father, Gary, drives a truck for Weyerhaeuser; his mother, Elaine, is an industrial nurse at a plastics company in Nashville. Gary used to take Kevin and his younger brother, Drew, deer hunting and fishing. In high school, Kevin was a nose guard for the Dierks High Outlaws. "I was an average player on an average team," Pannell admits, but he still has a passion for the game. His favorite team remains the gritty but often overmatched Cleveland Browns. "The Packers and the Cowboys never got their uniforms messed up," he says. "But the Browns' uniforms would be muddy and torn, and the players would have blood running down their arms. They lost hard."

In 1996, while still a junior in high school, Pannell joined the Arkansas National Guard. "I liked the camaraderie," he says. "It was like being in a fire department." The following year, after graduation, he worked as a machine operator and then a plumber's apprentice.

In 1999 he married Amanda. "It was so redneck how we met," he says, while she looks on, laughing and nodding. It was at a stock car race in Glenwood, Ark., where 17-year-old Amanda Tigue had come to watch her father race his Camaro on the high-banked clay track.

The couple settled into Pannell's mobile home. After Hunter was born in 2001, they moved to a four-bedroom house on 2½ acres. "Having a baby settled me down a lot," Pannell says. "My priorities changed—from all-night beer parties to watching 'Blue's Clues' every night."

While at Walter Reed, Pannell makes therapeutic outings on Fridays with Amanda and Hunter—a visit to Arlington National Cemetery, the Lincoln Memorial, the National World War II Memorial or a shopping mall. Naranjo considers it an important part of rehab. "You've just come

from Iraq, and you're healing in a military installation," he says. "At some point you need to be exposed to things like malls, with little kids running up to you, staring. You have to learn to try on clothes and maneuver in stores. I need to make sure he can handle the necessities of living."

PANNELL'S WAR ENDED at about 5:30 pm on June 13, 2004. His 12-man unit was on a foot patrol in a run-down, insurgency-ridden neighborhood in central Baghdad that the soldiers called "Little Fallujah." "If we got shot at, it was still a routine patrol," says Pannell, whose company had arrived in the Iraqi capital on April 1. "Getting hit by grenades was routine."

Decked out in Kevlar helmets and Interceptor Kevlar flak vests reinforced with steel plates, the unit proceeded in staggered lines on either side of Sheik Maruf Street, a cobblestone thoroughfare intersected by narrow alleys.

As the unit approached Haifa Street, Pannell heard a scuffling sound. "I looked behind me," he recalls, "and saw a grenade rolling past Sergeant Greg Parker. Someone yelled, 'Grenade!' "

It rolled against Pannell's right foot and exploded, knocking him off his feet. Temporarily deafened, he stood, right foot angled backward, and looked for Spc. Kevin Kelley, his best friend in the platoon and a fellow Razorback. He saw him across the street. "You're trained to yell 'medic' if you're hurt," Pannell says. "In my mind I was yelling 'medic,' but out of my mouth came 'Kelley.' "

He stumbled 25 ft. to his buddy, who grabbed Pannell by his flak vest and eased him down against a wall. Platoon medic Pfc. Bradley "Doc" Lawing ran over and saw immediately that Pannell was gray and going into shock. As the rest of the unit formed a security perimeter, Lawing tied tourniquets on Pannell's legs and right arm. "He kept falling into unconsciousness," Lawing recalls, "so Kelley kept slapping him awake."

Pannell left 6 pints of blood on the ground in the alley. Thirteen minutes later, after a 3-mile ride in a Humvee through the chaotic streets of Baghdad, Pannell lay on a hospital bed in the 31st Combat Support Hospital's emergency room. He could hear the physicians talking about

"Someone yelled 'grenade,'" Pannell recalls. It rolled against his right foot and exploded, knocking him off his feet.

him, and it didn't sound good. He asked his platoon leader, 2nd Lt. Cole DeRosa, to give his unit a message. "Tell the guys I'm standard," he said, using Army parlance for "I'm okay." He added: "Tell them I went down swinging." Then the oxygen mask descended.

An Army surgical team cleaned shrapnel and debris out of the wounds, trimmed shredded muscles, repaired torn vasculature, and tried to maximize blood supply to his

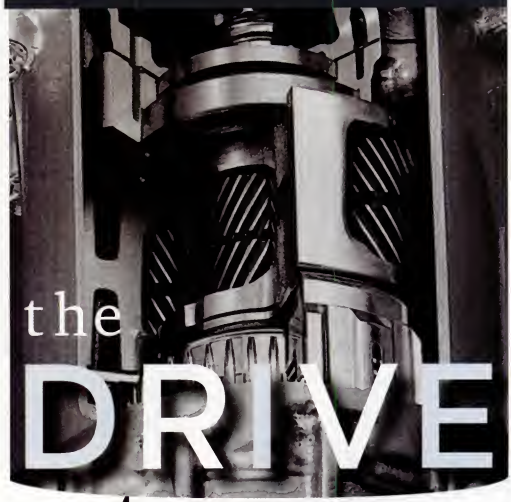
SUPPORT GROUP: Pannell's wife, Amanda, and his prosthetist, Dennis Clark, at Walter Reed. The medical center handles virtually all of the military's combat amputees.

shattered legs. The still-unconscious soldier was then loaded on a C-141 transport outfitted with a mini intensive care unit for the 9-hour flight to Landstuhl Regional Medical Center in Germany. Pannell spent less than 24 hours in Landstuhl—just long enough for a second operation to restabilize the soft tissue injuries and wash out more debris.

Next came the 10-hour flight to Andrews Air Force Base, near Washington, D.C., and the short ambulance ride to Walter Reed, where Pannell's wife and parents were waiting. Five days and two operations later, Pannell's orthopedic surgeon, Maj. Kevin Kirk, walked into the waiting room to talk about choices with Amanda and Pannell's parents. Pannell's condition had continued to deteriorate, and it was clear that his legs were killing him—they were gangrenous. Pannell's father was unequivocal: "We want Kevin," he said.

(Please turn to page 134)

how it works



the DRIVE train

by don chaikin

WHETHER YOU DRIVE a 500-hp sports car or a 96-hp economy hatchback, all that potency under your car's or truck's hood is useless if the engine's torque doesn't get to the drivewheels through a complex maze of gears. In fact, the drivetrain may be the least understood part of a vehicle. New innovations in four-wheel and all-wheel drive have only made that confusion worse for many drivers. Here's a primer to help explain that mystery under the floorboards: what really happens when you press down on the accelerator.

FRONT-WHEEL DRIVE

Though front drive can be found in such classics as the 1929 Cord, the overwhelmingly popular modern configuration is based on the 1959 Mini. Its creator, Sir Alec Issigonis, put the small engine transversely—sideways—under the hood, mounted the transmission and differential in one unit called a transaxle, and installed that underneath and to the rear of the engine. While some front-drivers have a longitudinally—front-to-rear—mounted drivetrain, all the components are still up front. Because the front wheels must steer as well as propel, they are connected to the axle halfshafts via complex universal joints, called constant velocity joints, which can transmit power smoothly while severely articulated.

PRO

- More room for people and cargo.
- Better fuel economy due to reduced weight.
- Improved wet-weather traction thanks to the weight over the drivewheels.

CON

- Increased wear on front tires and suspension.
- Cramped engine compartment makes service difficult.
- Limits to amount of power the front wheels can handle without making steering unpredictable.
- Reduced wet-weather traction on upgrades.

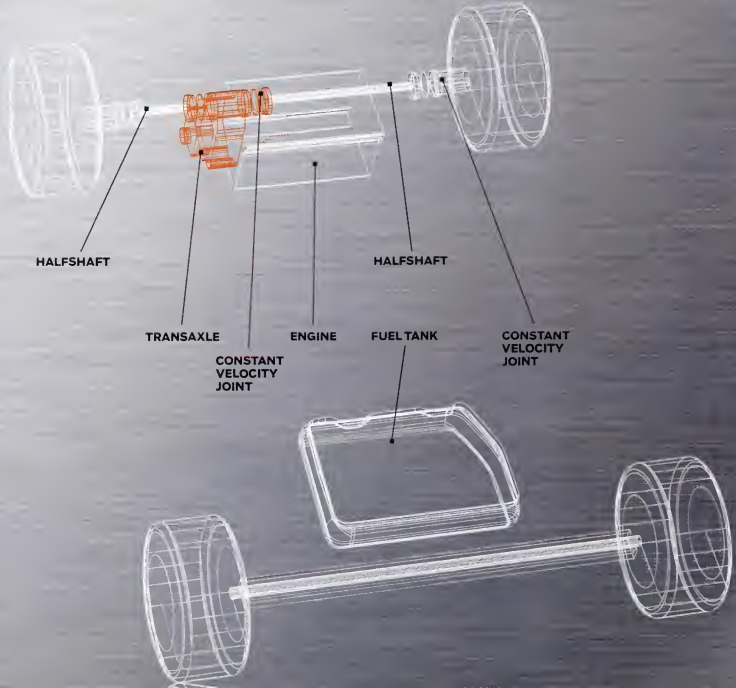
ILLUSTRATIONS BY STEVE KARP

TRANSAXLE

The operation of any transaxle is exactly the same as that of any transmission. The difference is this: Instead of being connected via a long driveshaft to the rear axle, the transmission's output shaft drives a large gear that meshes directly with the differential's ring gear. And the differential itself (which would be mounted on the rear axle in a rwd car) is located in the transaxle housing, mounted parallel to the transmission. As power is applied, the differential distributes it to the two front wheels via halfshafts.

CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

CVTs are gaining popularity and are used in several new Fords, Saturns and Audis. Instead of gears, the CVT uses a belt between two pulleys. One is driven by a shaft from the engine, the other drives a shaft to the differential unit and drive axles. Both pulleys are split so that their halves can slide closer together and farther apart. As the belt rides higher and lower in the pulleys, the effective gear ratios between the driving and driven shafts change.



how it works

REAR-WHEEL DRIVE

Still the classic, rear drive was basically the only drivetrain system for many years. A longitudinally mounted engine, with the transmission bolted directly to it, sends power via a driveshaft to a differential unit at the rear axle. The differential turns the power 90° and sends it to the rear wheels. (Some sports cars such as Corvettes, Ferraris and Porsches place a combined transmission and differential—or transaxle—in the rear.)

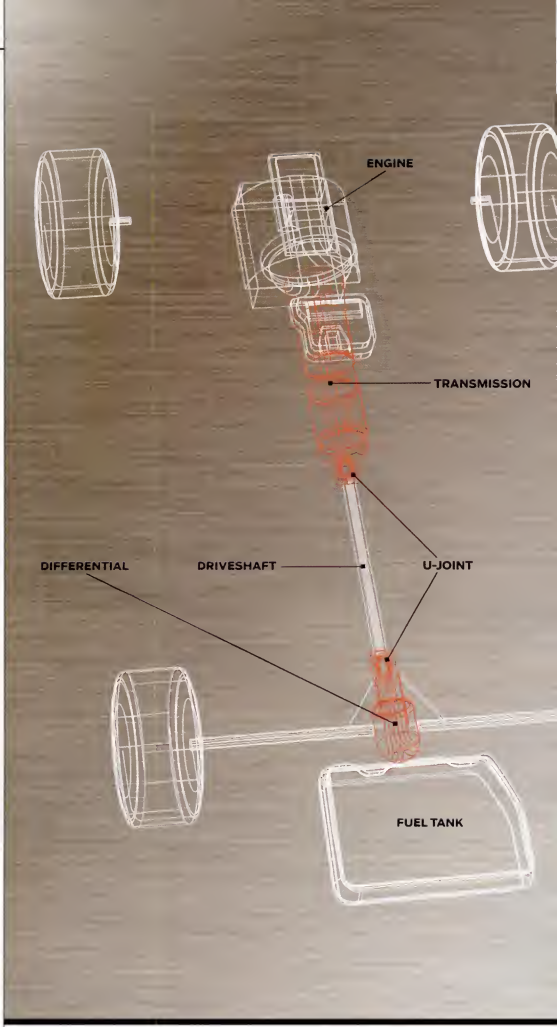
The driveshaft connects via yoke-type universal joints and a splined expansion joint to allow for vertical and longitudinal suspension movement.

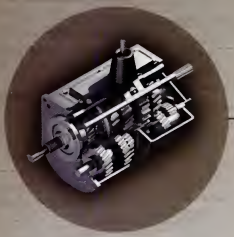
PRO

- Better front/rear weight distribution results in nimbler handling.
- Ease of service thanks to spread-out components.
- Less wear and tear because the front tires don't have to both steer and pull the car.

CON

- Poor wet-road traction and stability without sophisticated electronic controls.
- Reduced passenger and cargo room.





MANUAL TRANSMISSION

The gearbox is mated to the engine via a spring-loaded clutch plate faced on both sides with friction material. The clutch must be disengaged to shift gears, and the transmission must be in Neutral, or the clutch disengaged, for the vehicle to be stopped while the engine is running. The transmission consists of an input shaft from the engine and an output shaft to the drivewheels. The input gears can slide back and forth to mesh with their output mates. Synchronizer cones between the sliding gears and shaft allow smooth shifting. Reverse gear is on its own shaft.

AUTOMATIC TRANSMISSION

An oil-filled torque converter that multiplies engine torque inside the transmission bellhousing allows some slippage so the vehicle can be stopped while the engine runs. A friction clutch built into the center of the converter locks its input and output shafts to the same speed for highway cruising. Computer-controlled hydraulic pressure selects which combination of gears within several planetary sets can rotate, changing the ratios between the input and output shafts.

OPEN DIFFERENTIAL

While cornering, the outside wheels cut a wider arc than the inside. The differential needs to ensure that the outside and inside wheels are allowed to turn at different speeds—hence the name—while still supplying power to both wheels. The basic differential housing contains a large ring gear that meshes with a small pinion gear driven by the driveshaft. The ratio between the ring and pinion gear is known as the final-drive ratio or rear-axle ratio. The ring gear also spins a carrier containing perpendicularly meshing spider gears that allow the left and right axle shafts to spin independently. Downside: The wheel with the least traction limits power applied to the road.

LIMITED-SLIP DIFFERENTIAL

The concept of providing traction to the nonslipping drivewheel with a limited-slip differential dates back at least to the late 1950s. Though there are now many wrinkles to the old theme, the essentials are the same. The spider gears are mechanically linked to share torque regardless of conditions. This can be done simply by adding spring-loaded clutch packs that keep the spider gears from spinning. Power then flows to both wheels to the limit of the clutch packs' capacity. The spiders can also be pneumatically or electrically locked together—but this defeats the differential function.

ILLUSTRATIONS BY PAUL DINARE (MANUAL TRANSMISSION; OPEN DIFFERENTIAL)

how it works

FOUR- & ALL-WHEEL DRIVE

From a traction point of view, the best of all worlds is when both front and rear wheels are propelling the vehicle. However, the front and rear axles rotate at different speeds except when driving in a perfectly straight line. So the only way both can power the vehicle on dry-road turns is if there's a differential between them. (On slippery surfaces the tire slippage compensates for the wheel-speed differences.)

Many awd vehicles share much of their drivetrain with similar front-drive models but add a compact center differential, driveshaft and rear differential. Four-wheel-drive vehicles use a transfer case placed after the transmission that directs power to both the front and rear axles when needed. When engaged, the transfer case drives two separate driveshafts that operate individual differentials. No center differential is used on true 4wd vehicles going off-road in 4wd mode.

PRO

- Maximum traction on a variety of surfaces.

CON

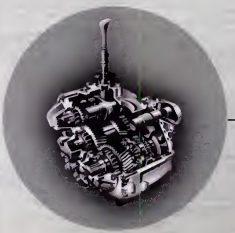
- Added weight, which reduces fuel economy.
- More things to break.
- Higher cost.

VISCOUS COUPLING

This is a differential with no gears. The input shaft from the transaxle (at the front wheels) and the output shaft to the rear wheels each carry a series of plates that are alternately intertwined and closely spaced. All the plates swim in a special fluid that transfers power from the input to the output plates when needed. If the front-drive wheels begin to slip, their shaft and plates spin more quickly than the others. This speed differential within the housing churns and heats the fluid, which thickens it and more tightly bonds the alternating plates. Some torque is now sent to the grippier wheels until spinning ones regain traction.

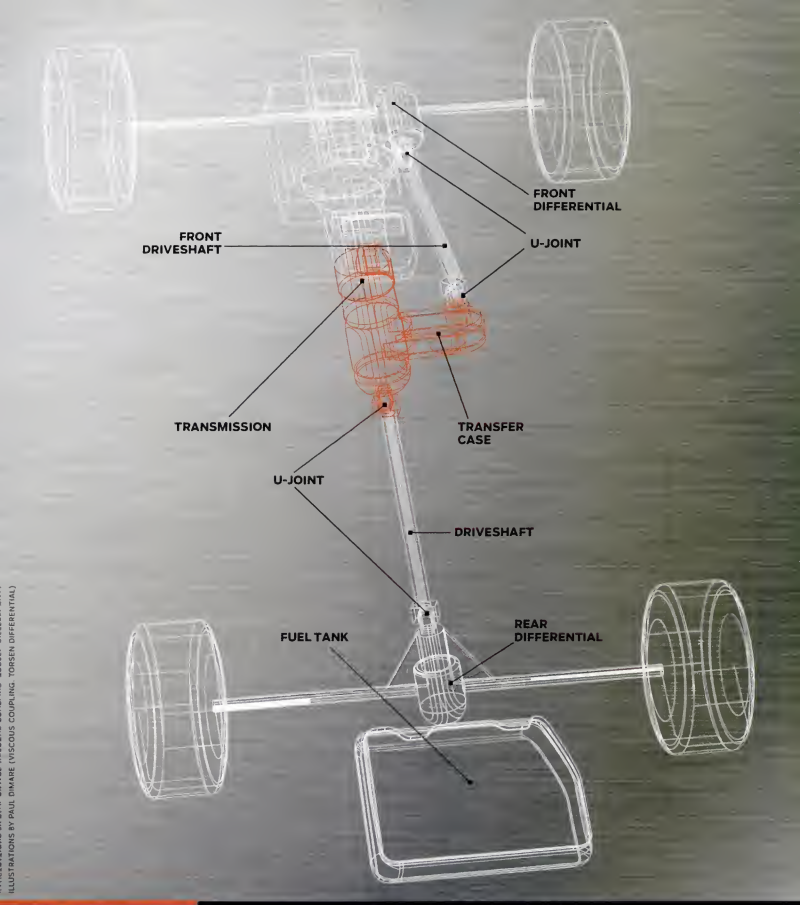
TORSEN DIFFERENTIAL

The Torsen dates back to 1983. Since then it has been used by various carmakers, including Audi and Hummer. The Torsen multiplies what torque is available from the axle that is starting to spin or lose traction, and sends it to the slower-turning axle with better traction. The gears allow a torque-bias ratio of 4:1, which means they can deliver four times as much power to the nonslipping axle than can be supported by the slipping axle. One big advantage of Torsen systems is that because they are purely mechanical they react very quickly to slip.



TRANSFER CASE

This is a separate gearbox mounted behind the transmission. Power goes to the transfer case to be directed to the rear wheels only or to both front and rear. A separate driveshaft connects the transfer case to a differential in the front axle. Most transfer cases also offer two gear ratios, for a High and Low range. While many vehicles still have a manually engaged transfer case, several now offer electrically activated engagement.



ILLUSTRATIONS BY PAUL DINAIRE (VISCOUS COUPLING, TORSEN DIFFERENTIAL)

futureDRIVE

Two decades from now, you can expect that the power to move your vehicle will be electric. It will likely have a relatively small electric motor for each wheel, and the concepts of front-, rear- and all-wheel drive will become obsolete. The electronics will be able to direct power to any one wheel, to all wheels at the same time, or to any combination. Either a hydrogen fuel cell or an internal-combustion engine running on hydrogen turning a generator will supply the electricity. As fuel cell development costs are still staggering, a more economic alternative might be to replace gas stations with hydrogen filling stations. **PM**

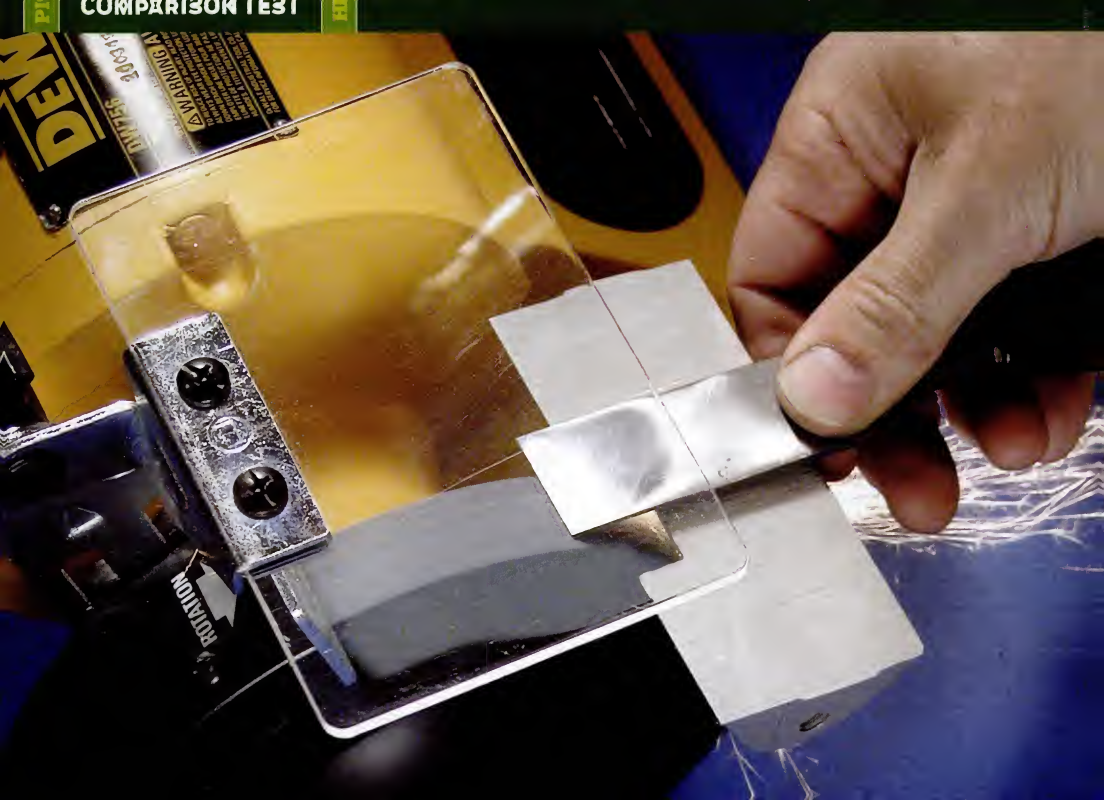
Home Journal

True Grit

Cutting-edge bench grinders in a wheel-to-wheel test.

TEXT AND PHOTOS BY THOMAS KLENCK

Most woodworkers don't want to spend time sharpening their tools—they want to cut and fit wood. And with a shop full of power tools and carbide-tipped blades, bits and cutters, it may almost seem like sharpening is a thing of the past. The truth is, as long as there are chisels, planes, gouges and turning tools, every woodworker must still develop some skill in shaping the edges of hardened steel—and a good bench grinder is the best place to start.


DEW
WARNING
ROTATION

Bench grinders aren't designed for precision work. In fact, they're really freehand tools that rely on a good eye and careful touch. And while you can take some tools, like drill bits or turning tools, right from the grinding wheel to the work, it's common for grinding to be a relatively coarse, preliminary shaping procedure, followed by careful honing on a whetstone.

Of course, grinders have a place outside the woodshop, too. They're ideal for sharpening scissors, garden shears, mower blades—even the edge of your garden spade will benefit from a pass over a coarse wheel. And, sharpening is not the only thing they do. Grinding is the fastest way to deburr a sharp corner or dress the end of threaded rod or bar stock that's been cut to length. Fit a grinder with a wire wheel, and you have a handy tool for removing rust. Then switch to a buffing wheel and you're ready to polish metal to a mirrorlike sheen. But for most of us, grinders are essential for shaping and sharpening hardened tool steel and high-speed steel. These are alloys that a file won't touch—you need a grinder for the job.

The basic bench grinder is a simple machine that's made up of little more than an induction motor with an abrasive wheel mounted at each end of the motor's shaft. Homeowner-grade and small-shop grinders come sized for either a 6- or 8-in. wheel. For our money, the 6-in. models handle basic grinding chores just fine, and the smaller-diameter wheel produces a deeper hollow grind—a plus if you use hollow-ground bevels to set your honing angle.

The typical garden-variety grinder comes with two gray aluminum-oxide wheels—a coarse 36-grit wheel and a fine 60-grit version. The coarse wheel is best for shaping and fast stock removal, while the fine wheel produces a smoother surface and is useful for touching up edge tools that don't

DEWALT DW756

What we liked: Solid construction and ample weight make this grinder the smoothest and quietest in our group. It also has the most powerful motor. The toolrests are wide and flat, and easily adjust to any angle. Flat, ⅛-in.-thick clear plastic eye shields are simple to replace with off-the-shelf material if they become dirty or scratched.
What we didn't like: Wheel-guard screws at the bottom of each guard are difficult to access if you've bolted the grinder to your bench.

SPECIFICATIONS

Estimated street price: $90
Power: 4 amps
Wheel speed: 3450 rpm
Wheel type/grit: gray/36 and gray/60
Weight: 28.5 lb.
Accessories: Toolrests, spark deflectors, eye shields, wrench.

DELTA GR250

What we liked: This tool has great extras such as a gooseneck lamp, V-groove toolrest for touching up drill bits and a friable white wheel for cooler grinding. The variable-speed motor allows you to slow down so you reduce the chance of overheating fine edges. The grinder is smooth running and quiet.
What we didn't like: This model is shipped with the white wheel behind the V-groove rest, which is inadequate for supporting chisels (our photo was taken after we moved the white wheel to the standard rest). Mating surfaces between toolrests and support brackets have radial teeth, or detents, that prohibit fine angle adjustment of the rests.

SPECIFICATIONS

Estimated street price: $74
Power: 2.5 amps
Wheel speed: 2000 to 3450 rpm
Wheel type/grit: gray/60 and white/60
Weight: 25 lb.
Accessories: One standard and one angled V-groove toolrest, spark deflectors, eye shields, wrench, wheel dressing tool, lamp.

CRAFTSMAN 21152

What we liked: The wire brush adds versatility, and variable speed allows you to slow down for careful sharpening of fine edges. An angled V-groove toolrest for drill bits is included in addition to two standard rests. This craftsman tool also comes with a star wheel dresser so you can renew the grinding wheel surface for faster cutting.
What we didn't like: The motor seems a bit underpowered for heavy wire-brush use. The single grinding wheel is too fine—a coarser 36-grit wheel would be a better general-purpose choice.

SPECIFICATIONS

Estimated street price: $80
Power: 2 amps
Wheel speed: 2000 to 3450 rpm
Wheel type/grit: gray/60 and wire brush
Weight: 28 lb.
Accessories: Two standard toolrests, angled V-groove toolrest, spark deflectors, eye shields, wrench, wheel dressing tool, lamp, cooling tray.

BLACK & DECKER BT3500

What we liked: The B&D has separate lamps for each wheel that turn on with the grinder On/Off switch—and bulbs come with the tool. (Lamps on other grinders have independent switches and bulbs aren't included.) This is a grinder with good performance at a modest price.
What we didn't like: The motor housing gets very warm after continued use, and the toolrests lock in detents, making precise angle adjustment impossible. No wrench for adjusting the toolrests' hexhead bolts is included.

SPECIFICATIONS

Estimated street price: $50
Power: 3.5 amps
Wheel speed: 3600 rpm
Wheel type/grit: gray/36 and gray/60
Weight: 21 lb.
Accessories: Toolrests, spark deflectors, eye shields, lamp, cooling tray.

RYOBI BGH615

What we liked: The price makes this grinder a bargain, particularly since it comes standard with 36- and 60-grit wheels, amber-tinted eye shields and a gooseneck lamp.
What we didn't like: The motor takes longer to come up to speed than the other grinders. Toolrests are horizontal and not adjustable. Wheel-guard covers secured with bolts, nuts and washers, rather than screws threaded into tapped holes.

SPECIFICATIONS

Estimated street price: $40
Power: 2.1 amps
Wheel speed: 3600 rpm
Wheel type/grit: gray/36 and gray/60
Weight: 22 lb.
Accessories: Toolrests, spark deflectors, eye shields, lamp, angled V-groove toolrest.

require further honing. You'll also find white wheels on some grinders. These are made of aluminum-oxide grit, but feature a different binding material that allows the wheel surface to break up and renew itself as it is used. These friable wheels run cooler than the gray wheels and resist clogging, reducing the chance of overheating the fine edge being sharpened and drawing the temper of the steel. The tradeoff, of course, is that white wheels wear out more quickly.

All bench grinders have a toolrest in front of each wheel. At its simplest, the rest is designed as a brace on which to steady the work against the rotation of the wheel, but most do more. By adjusting and setting the toolrest angle, it's easier to create the consistent bevels required on chisels and plane irons. Some toolrests incorporate an angled V-groove to help in touching up drill bits. In addition to toolrests, all bench grinders have an adjustable eye shield above each wheel, and you'll find a spark deflector under the shield at the top of the wheel guard. Other options include water trays for cooling the workpiece, one or two built-in lamps and variable-speed motors. Speed control may be of use since a slower speed generally means cooler grinding.

CHOICE GRIND

A good grinder needs to have solid, fully adjustable toolrests and a smooth-running, quiet motor with ample power to drive both coarse- and fine-grit wheels. Within our group, the DeWalt best meets these basic requirements.

Both the Delta and Craftsman grinders are outfitted with some features that make them more specialized than they should be. V-groove toolrests and wire wheels are best included as accessories or offered as options that users can add as their needs grow. And, any angle adjustment mechanism that presets angles—even in small steps—should be avoided. The only bench grinder in our group without this problem is the DeWalt.

The Black & Decker entry would be our low-cost choice—especially for preparing woodworking tools for honing. The Ryobi can be had for even less money, but go for it only if careful bevel grinding isn't on your to-do list in the shop.

Both the Delta 23-710 and Veritas MK II (see "Grinder Alternatives," above) are dedicated sharpening systems that incorporate rotary honing capability in addition to coarser shaping. Of the two, the Delta has the most potential if you factor in the accessory that's available for jointer and planer knife grinding. When it comes to painless and consistent bevel grinding, however, the Delta is no match for the Veritas offering. The MK II simply has the best bevel-angle setting system we've seen. PM

For more home features check out the PM.Zone Web site
@ POPULARMECHANICS.COM/HOME

GRINDER ALTERNATIVES

BENCH grinders are general-purpose machines—just as happy in a woodshop as your local garage. Woodworkers who want something designed more to their needs do have a few options, though.

DELTA 23-710 SHARPENING CENTER

Price: $156

This unique machine combines traditional grinding with a horizontal wet wheel for motorized honing. It has a sophisticated toolrest to hold chisels and plane irons at precise angles. The toolrest also can be used with the grinding wheel, and you can get a sliding accessory for grinding and honing jointer and planer knives.

Power: 2.5 amps
Grinding wheel specs: 3450 rpm, 120-grit, 2-in.-wide, 5-in.-dia. white wheel
Honing wheel specs: 400 rpm, 1000-grit, 8-in.-dia. wet wheel
Weight: 42.5 lb.

VERITAS MK II POWER SHARPENING SYSTEM

Price: $300

This machine uses adhesive-backed abrasive discs that are mounted on metal plates, and a sliding tool holder that maintains consistent bevel angles.

Unlike traditional grinders, the Veritas system produces a flat-ground bevel. Once this is shaped with a coarse abrasive disc, a thinner plate with a fine disc hones a finished microbevel at the edge. For razor-sharp tools, the system is foolproof and fast. The Veritas MK II is available from Lee Valley, 800-871-8158; www.leevalley.com.

Power: 3.25 amps
Abrasive discs: 8 in. dia.
Grits: 80, 150, 320, 1200
Weight: 42.5 lb.

MEASURE FROM HERE TO THERE WITHOUT EVER GOING THERE.

At the touch of a button, the Craftsman® Laser Guided Measuring Tool can tell you the distance from one wall to another. It also calculates square footage and volume. All of which comes in handy when you want to know how much paint to buy or how much new flooring you'll need. Available at Sears and Sears Hardware Stores. Or go online at craftsman.com.

SEARS
Good life. Great price.

CRAFTSMAN®
MAKES ANYTHING POSSIBLE®

© 2004 Sears Brands, LLC

*Spirals can use less than half the floor-space of a traditional stair!**

Free up valuable square footage with a space-saving spiral stair kit from The Iron Shop, in metal, oak, Victorian inspired cast-aluminum, or custom all-welded metal units. The Iron Shop's spiral stairs start at only $425 and are available in diameters ranging from 3'6" to 7'0", spanning almost any height.

Since 1931, The Iron Shop has enjoyed a reputation for outstanding design and fabrication of spiral stairs. Today, by utilizing computer-aided technology throughout our production process we guarantee that each stair meets only the highest standards—successfully mixing state-of-the-art manufacturing with Old World quality.

Call for the FREE color Catalog & Price List:

***1-800-523-7427** Ask for Ext. PM*

or visit our Web Site at www.TheIronShop.com/PM

Main Plant & Showroom: Dept. PM, P.O. Box 547, 400 Reed Road, Broomall, PA 19008
Showrooms / Warehouses: Ontario, CA • Sarasota, FL • Houston, TX • Chicago, IL • Stamford, CT

*Calculations are based on the floor-space requirement of The Iron Shop's 3'-6" diameter metal spiral stair kit versus the required floor-space of a traditional 42" straight stair, spanning a typical 9'0" floor-to-floor height.

NASCAR® is a registered trademark of the National Association for Stock Car Racing, Inc. All other logos, trademarks and service marks are property of their respective owners. As such, no materials from this ad may be reproduced without said owners written permission.

THE IRON SHOP®

The Leading Manufacturer of Spiral Stair Kits®

©2003 The Iron Shop

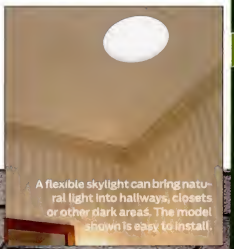
Sunshine In A Box

This easy-to-install skylight tube brightens dark hallways. **BY JOSEPH TRUINI**

A **traditional skylight** has lots of advantages, such as good looks and the fact that it admits plentiful daylight. But it has one major disadvantage. Installing one is a complex project that involves cutting rafters, reframing the ceiling below, lots of drywall work and sometimes working with complicated trim. An easier way to let sunlight into a dark area is with this flexible tubular skylight, a product that can be installed between rafters. The best part of the installation is that it hardly disturbs the roofing. Sure, you cut a hole in the roof, but the skylight comes with a well-engineered assembly that simply slides under the shingles on the uphill side of the roof. The result is a worry-free and weather-tight installation.

The skylight we show here is ideal for do-it-yourself installation. It consists of a clear dome, a flexible shaft with a highly reflective interior, and a diffuser lens that attaches to the ceiling. The lens diffuses sunlight, creating a soft illumination.

For this project, we chose a 14-in.-dia. Velux Sun Tunnel Model TSF-014, a $240 product with a 6-ft.-long flexible shaft that easily bends around obstacles in the attic. It can be installed by an experienced person in about 3 hours. Contact Velux at 800-283-2831; www.veluxusa.com.



A flexible skylight can bring natural light into hallways, closets or other dark areas. The model shown is easy to install.

PHOTOS BY VIC COTTO

Hold the skylight's diffuser ring against the ceiling and trace around its perimeter with a sharp pencil.

Before cutting, check the attic for wiring. Put on goggles and a dust mask, then cut the circular hole in the ceiling with a drywall saw. Use a tarp to catch debris.

Use a cordless drill to fasten the round diffuser ring to the ceiling with the four screws provided.

Join together the 3-in.-wide steel ring and the flexible tube with one wrap of duct tape. About 1½ in. of the ring should protrude beyond the tube.

Fasten the steel ring and flexible tube to the diffuser ring. Use a cordless drill to drive four equally spaced screws just above the flange of the diffuser ring.

Nail the drywall cutout from the ceiling to the underside of the roof. Center it between two roof rafters.

Now remove the cutout and drive the nail completely through the shingles. Bring the cutout on top of the roof and push it onto the nail, then trace its perimeter on the shingles.

Bore a hole on the circle's perimeter to begin the roof cut with a reciprocating saw, or make a plunge cut. Work along the cutout line, being careful not to damage surrounding shingles.

RENT OR BUY?

Reciprocating Saw

A tricky aspect of home remodeling is figuring out whether you should buy or rent the tools you need. You're already saving money by doing the work yourself. Do you want to take the savings and plow them into your toolkit—or leave them in the bank? If you're an ambitious homeowner, the answer is easy: Buy. Otherwise, it's probably best to rent. Reciprocating saws cost from $60 for a homeowner model to $350 for a cordless professional model with two batteries. The DeWalt shown here costs about $200 and comes with a charger, carrying case and the latest nickel-cadmium battery technology. To rent a saw from a home center, expect to pay $25 to $30 per day. A pack of blades will cost about $6.

PHOTOS BY VIC COTTO

Use a pry bar to lift the asphalt roof shingles surrounding the upper half of the hole, then slide the metal skylight frame under the felt underlayment. When the frame is positioned, nail its upper corners.

Drive a nail through each of the frame's two lower corners. Cover the nail-heads with roofing cement.

Gently pull the 6-ft.-long flexible tube through the hole in the frame. Stop pulling when the tube feels taut.

Hold the excess tube above the top of the frame and trim off the excess with a utility knife. Make the cut about 3 in. above the frame's top edge.

Pinch closed the locking snap ring and set it into the tube. Let go and let the ring snap into place so it can force the flexible tube against the frame.

MONEYSAVING TIP

IF you want to install a tubular skylight and save a little money in the process, go with a rigid-tube skylight that has a 10-in. diameter. It costs $160 (an $80 savings over the $240 product installed for this article). The major differences between the two products are that this light is 4 in. smaller in diameter and has a rigid tunnel. From the outside, the tunnel looks like standard steel duct. Actually, it's aluminum with a highly reflective vapor-deposition coating on the inside. It's also available in a 14-in.-dia. size. Alas, that's more expensive than the 14-in. flexible model. It costs about $290.

Gently slide the 4-in.-wide upper ring into the tube, then peel off the blue protective film from inside the ring.

Set the clear acrylic roof dome on top of the skylight frame and attach it with four 1-in. screws. The screws need to be no more than snug tight.

Inside the house, flex and angle the diffuser to fit it through the diffuser ring. Then let it drop down into place. PM

PHOTOS BY VIC COTTO

Using A Circular Saw

How to get the most out of this basic tool. **BY STEVE WILLSON**

A portable circular saw is one of the basic tools that should be in any homeowner's toolbox. With it you can cut any kind of wood or plywood quickly and accurately. Circular saws are available in various sizes, with different features, and in a pretty wide price range, from about $60 for a good entry-level tool up to $150 for something that might last a lifetime. The default tool and one that every manufacturer makes is the 7¼-in. model. This number designates the diameter of the blade that the tool holds.

This model is the most popular because it can cut through 1½-in.-thick lumber (2 x 4s, 2 x 6s, etc.) in a single pass—at 90° and when the foot is tilted, at 45°. High-end saws have amp ratings of around 15, while less expensive consumer saws have motors that draw around 10 amps.

Unlike the other basic power tool that everyone should have, the portable electric drill, there aren't many accessories available for a circular saw. Specialty blades and a rip fence (both shown here) are about your only choices.

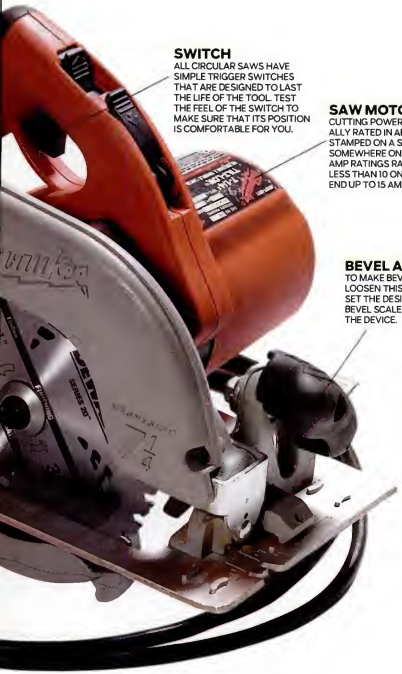
This tool is easy to use. However, it tends to be very loud, can create a lot of dust and is deceptively dangerous. Because it's compact, relatively lightweight, and its blade is nearly always covered by either the guard or the wood you are cutting, it's easy to become careless when using it. Make sure you understand the safety instructions that come with the tool, and follow them carefully whenever you are working.

BASIC ADJUSTMENTS

ALL CIRCULAR SAWS can be adjusted in two ways: for depth of cut (left) and for angle of cut (right). Reducing the depth of cut allows you to cut grooves and slots across the face of a board. Adjusting the angle makes bevel cuts possible, usually up to 45°. Always unplug the saw when making either adjustment.

BLADE BUSINESS

DIFFERENT blades are available for making special cuts. Your best default choice is a 40-tooth carbide-tipped blade (top). An abrasive blade (middle) lets you cut masonry



SWITCH
ALL CIRCULAR SAWS HAVE SIMPLE TRIGGER SWITCHES THAT ARE DESIGNED TO LAST THE LIFE OF THE TOOL. TEST THE FEEL OF THE SWITCH TO MAKE SURE THAT ITS POSITION IS COMFORTABLE FOR YOU.

SAW MOTOR
CUTTING POWER IS USUALLY RATED IN AMPS AND IS STAMPED ON A SPEC PLATE SOMEWHERE ON THE SAW. AMP RATINGS RANGE FROM LESS THAN 10 ON THE LOW END UP TO 15 AMPS.

BEVEL ADJUSTMENT
TO MAKE BEVEL CUTS, YOU JUST LOOSEN THIS LEVER OR KNOB, SET THE DESIRED ANGLE ON THE BEVEL SCALE, THEN RETIGHTEN THE DEVICE.

products. A standard high-speed steel blade (bottom) usually comes with the saw. Some saws come with an arbor lock button (below) that holds the shaft while you twist off the blade nut.

CLASSIC CUTS

CROSSCUTS Nearly perfect crosscuts can be achieved by using a square to guide the foot of the saw. You must hold the square firmly or the saw can slip.

RIP CUTS Accurate rip cuts can be made with the help of a rip fence. This device slides into the foot of the saw and is held tight by screws.

PLUNGE CUTS These cuts are required when the blade can't start at the edge of the board. To make this cut, place the front of the shoe against the workpiece. Then, turn on the saw and slowly lower the blade into the material.

Answers To Your Home Improvement Questions

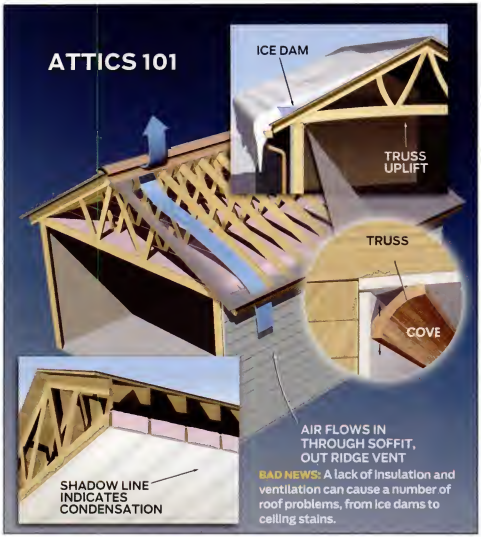
Expert advice on topics from attics to smoke detectors.

BY NORMAN BECKER, P.E.

Attic Problems

Every winter we have severe ice dams at the edge of our roof and parallel dark lines form on the upstairs ceiling that indicate the position of the roof trusses. We also get cracks around some of the upstairs ceiling and wall joints. The house does not have a ridge vent, but it does have a large gable fan for air circulation. How can we prevent these problems?

JIM SCHAEFFER
Via Internet



You have a number of problems that have been covered previously in this column: ice dams, poor ventilation, shadow lines and truss uplift. The best way to minimize conditions that result in an ice dam is to have a cold roof deck. This can be accomplished by installing a thick layer of attic insulation. Since using batt or roll insulation in an attic with roof trusses is more difficult than one with rafter framing, your best bet is to use loose-fill or blown-in insulation. In houses that do not have trusses, installing an extra layer of insulation is as simple as placing unfaced fiberglass insulation at right angles to the existing insulation. With either insulation be careful not to cover any recessed lighting fixtures that are not rated for insulation contact.

If there's a hatchway into the attic, build a cover for it out of rigid polystyrene insulation.

As for ventilating the attic, a large gable-end fan will not do the job, especially during the winter months. These fans are generally used for cooling the house during the warmer months. And since the fan is not used in the winter, its louvers will be closed, preventing air from moving out of the attic. The best way to ventilate the attic is through a ridge vent and soffit vents.

The dark lines in the ceiling are called shadow lines. Although there may be insulation on the attic floor, the bottom chords of the trusses are usually not covered. They are exposed to the low winter temperatures and act like a thermal bridge to the ceiling below. This creates a cold strip on the ceiling on which condensation forms. Over time, this

(Please turn to page 114)

ILLUSTRATION BY GEORGE RETSECK

REVIEW KITCHEN REMODELING

FEW rooms are as difficult to remodel as a kitchen. This critical space has large electric or combustion appliances, built-in cabinets, counters, plumbing connections and ventilation. Sometimes it even has complex color schemes, elaborate wood trim, fancy lighting, and a tile floor installed in an intricate pattern. No book can cover all of that (and still be small enough to lift in one hand). Still, our book makes a good start—if we do say so ourselves. It covers basic kitchen design as well as a range of makeovers from an economy job to a luxury model. Flooring, cabinets, counters, plumbing and electrical systems are discussed, if not exhaustively. The book has topnotch color photography and is loaded with tips from the pros: how to make a paper pattern to fit flooring tight as a drum, how to cut post-formed countertops, and so forth. It's a neat book that puts every one of its 192 pages to good use. It costs about $20 at bookstores. ***—Roy Berendsohn***

EarMate Hearing Aid Helps Thousands!

Free Trial!

Try It Today Risk-FREE!

From *The Wall Street Journal* 6/9/2004
EarMate-4000 comparison results:

★ "Sound was crisp and clear."
★ "With different tip sizes to choose from, this fit our ears the best, resulting in minimal feedback."

John Edmiston (Reporter)
Wall Street Journal, June 9, 2004
http://webreprints.djreprints.com/1005421313607.html

© Hearing Help Express, Inc™

Engineering Marvel

Advanced computer technology is used in the manufacturing process of your EarMate™. Greater precision means the highest quality possible.

"I am thrilled to bits with my hearing aid, it's an engineering marvel, how it can be made so small is absolutely amazing."
Col. Colin Mills - Arizona

Simple, Effective Design

The EarMate™-4000 is designed for the new hearing aid user. It is most appropriate for people with a mild to moderate hearing loss. The EarMate™-4000 hearing aid amplifies the high-frequency sounds that help you hear and understand.

"I can hear people talk better. I sometimes forget it is even in my ear. The price is just great. All I do is put it in my ear and I am ready to go." *M.M. - Rittman, OH*

"I can hear much more when watching TV."
Joseph English - New Jersey

You select from three sizes of soft ear tips to get a secure and comfortable fit. Easy-to-use volume control locks in your preferred setting - no more fumbling! Use your EarMate-4000 every day or just when you need a little extra help!

Only Available from Hearing Help

You order by mail from a family business with over 250,000 satisfied customers and 23 years selling hearing aids by mail.

Shipping is free. You try the EarMate™-4000 risk-free. You have a 45-day home trial and 100% money-back guarantee. Compare the EarMate-4000 to hearing aids costing $1,000 or more. Decide which is best for you!

"For me it as good as the $1,400 version."
D.G. - Lake Suzy, FL

"I am very pleased with my hearing aids. They have opened up a new world for me."
Raymond Hollaway - Tennessee

Customer testimonials on file, printed with their permission.

Free Information

Call 1-800-782-6897

ext. 09-329

Hearing Help Express™
105 North First St Dept 09-329
DeKalb, IL 60115-0586

Free Shipping!

☑ *YES!* Please rush me FREE information on the EarMate™-4000. I understand that I have no obligation & you provide FREE shipping. www.HearingHelpExpress.com/09329

Mr.Mrs.Ms. _____

Address _____

City/State/Zip _____

moisture traps dust and results in mildew growth, which shows up as shadow lines. First, clean off the mildew with a solution of 1 quart of bleach and 3 quarts of warm water. Rinse the surface with clear water, then let it dry.

If the surface has been stained from the mildew or is otherwise discolored, it will need to be painted. Apply a stain-blocking primer before applying a topcoat.

The cracks in the ceiling/wall joints are the result of truss uplift during the winter. The cracks could have been prevented by using brackets that allow the truss to lift without disturbing the drywall. The best way to deal with the problem now is with a molding that is wide enough to cover the cracks. Nail it to the truss so it is free to move up and down.

Electric Vs. Gas Water Heater

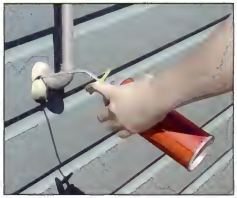
I am thinking about replacing my gas-fired water heater in my vacation home with an electric water heater. Are there advantages of an electric water heater over a gas water heater? Is there an electronic pilot for a gas-fired heater? Since I'm not in my vacation home for months at a time, I don't like to leave the pilot light burning because of fear of fear of fire.

ROD LUMPKIN
Via Internet

Each type of water heater has its advantages and disadvantages. With an electric water heater, there is no danger posed by an open flame, backflow of exhaust gases, incomplete combustion or carbon monoxide poisoning. Also, its heating elements are immersed in

SERVICE TIP MAINTENANCE

Foam Home



WHEN cold weather arrives, your first instinct is to button up—your house, that is. If you've spotted a number of daylight-admitting gaps in the basement or attic, or found drafty cold spots, you may be thinking about using some of that neat insulating foam you've seen at the home center. If you seal those gaps with foam, shop carefully to choose the right product. In chemical terms, you've got two basic choices: polyurethane and latex. If the job will be messy, consider using latex because the wet foam cleans up with water. Be advised: You've got to wipe it off right away. If it dries on your skin, the best way to take it off is with an old-fashioned pumice stone.

If mess isn't an issue, either material will work. You should also know that these products are available with expansion that ranges from 100 to 300 percent. Some are formulated for filling large gaps, while others are intended to squeeze into narrow gaps around doorjambs and window jambs. —*R.B.*

ILLUSTRATION BY GEORGE RETSECK

TOOLBOX

Snow Day

SOMETIMES dexterity is as important as brute force in outdoor power equipment. Toro designed its 11-hp 1128 OXE Power Max snowthrower with a bit of both. The machine drives forward with power to both wheels, but when you squeeze the trigger on the left or right handle, you cut power to that wheel and cause the machine to move in that direction. The machine has six forward speeds and two reverse.

Another convenient feature is its joystick-operated chute control that allows you to quickly swing the chute through 200° and place the snow where you want it.

The 28-in. 1128 OXE is the largest and most expensive of the five redesigned snowthrowers in the Power Max line, which encompasses machines from 7 to 11 hp. Their price range is $900 to $1800 at Toro dealers and some Home Depot stores. Visit www.toro.com for more information. —*R.B.*

(Please turn to page 116)

HUNTING FOR THE TOUGHEST 350? BULLS EYE.

THE NEW BRUIN 350 AUTOMATIC 4X4

Go on—hit it with your best shot. Because the new Bruin 350 is not only the toughest 350 out there—it's the only one with the industry's best On-Command® system that lets you switch from 2WD to 4WD with the push of a button. Plus, our exclusive Ultramatic® automatic transmission with all-wheel engine braking and independent double wishbone suspension delivers an ultra-smooth ride. After all, just 'cause you're tough, doesn't mean you can't be comfortable.

YAMAHA®

ATVs with engine sizes of 90cc or greater are recommended for use only by riders age 16 years and older. Yamaha recommends that all ATV riders take an approved training course. For safety and training information, see your dealer or call the ATV Safety Institute at 1-800-887-2887. ATVs can be hazardous to operate. For your safety: Always avoid paved surfaces. Never ride on public roads. Always wear a helmet, eye protection and protective clothing; never carry passengers; never engage in stunt riding; riding and alcohol/drugs don't mix; avoid excessive speed; and be particularly careful on difficult terrain. For the Yamaha dealer nearest you call: 1-800-88-YAMAHA yamaha-motor.com

water so no heat is wasted. You can install a timer to control the heating cycle to reduce energy use.

On the negative side, the recovery rate of an electric water heater is considerably less than that of a gas unit. The recovery rate is based on the heater's capacity and the amount of hot water it can produce in 1 hour. An electric water heater has a low recovery rate of about 18 gal. per hour. A gas water heater has a recovery rate in the range of 30 to 40 gal. per hour. To supply adequate hot water, the tank capacity of an electric water heater has to be a minimum of 52 gal.—many are as large as 80 gal. During those periods when no hot water is being drawn, a greater volume of water is being heated by an electric water heater than would be necessary with a gas-fired appliance.

It is not necessary to leave a pilot light on all the time on new gas-fired water heaters. All the major water heater manufacturers have units with an electronic ignition.

TOOLBOX

Winter Air Care

PEOPLE tend to associate indoor air quality problems with summer's hot and humid conditions, but a well-sealed house in winter is liable to have air that's pretty dirty, too. Dust, mildew, smoke and pet dander are every bit as present in the winter as they are in summer.

One way to improve indoor air quality is to trade up to a better furnace filter. 3M's Filtrete filter has been redesigned so that you change only its filter media—not the media and the heavy plastic frame. The 1-in.-thick filters are made from polyolefin plastic fibers that are electrostatically charged to increase their dust-trapping capability. The filters come in five models with each subsequent product having more filtration. The finest filtering model will trap anything from a large piece of lint to a smoke particle. Filtrete filters range in price from $5.50 to $20 at hardware stores and home centers. Visit www.3m.com. —*R.B.*

TOOLBOX

The Drive Way

THE iXO may look funny but the little cordless driver/drill means business. All 10.3 ounces of it. The palm-size tool is powered by a lithium-ion battery, which Skil says delivers the same performance as a nickel-cadmium battery but is half the size and weight. Aside from its obvious fun and compactness, it's practical. Forward and reverse arrows on top of the tool glow to indicate the direction in which the chuck is spinning. We tried the iXO and it's a powerful little brute. You can't use it to build a deck, but you can certainly assemble a barbecue with it. The iXO costs about $50 at hardware stores and home centers when accompanied with a 34-piece bit set. Visit www.skil.com.

One nice thing about this Craftsman screwdriver (left) is that it never needs recharging—you might, but that's another story. Another nice thing about it is that its tip articulates so you can get at those fasteners that are hard to reach. It also works as a conventional screwdriver because its locking collar threads into position behind the ball-joint tip. It costs $10 at Sears stores and through www.craftsman.com (item No. 47476). —*R.B.*

Roof Shingle Discoloration

What causes streaks on roof shingles?

FRED ALTIER
New Philadelphia, OH

The discoloration is caused by microscopic algae spores carried on the wind. The algae stains can be removed by washing the roof shingles with a commercial roof cleaner available at roofing supply stores and home centers. However, this is a temporary fix because the algae will return. To prevent the algae from returning, consider installing zinc roof strips. The oxides that wash off the strips act as an algicide. For more information, contact Chicago Metallic at 800-323-7164 or www.chicago-metallic.com.

If the shingles will need to be replaced soon, consider reroofing with an algae-resistant shingle. These roofing products are available from several manufacturers. The shingle looks like a standard product but it contains zinc or copper granules that kill algae.

Oilburner Problem

I have an oil-fired forced-air furnace. Its oilburner works until it gets cold (zero degrees), then it

(Please turn to page 118)

TO SEE WHICH HEAVY-DUTY PICKUP WAS AWARDED MOST DEPENDABLE, JUST RINSE.

GMC SIERRA HD

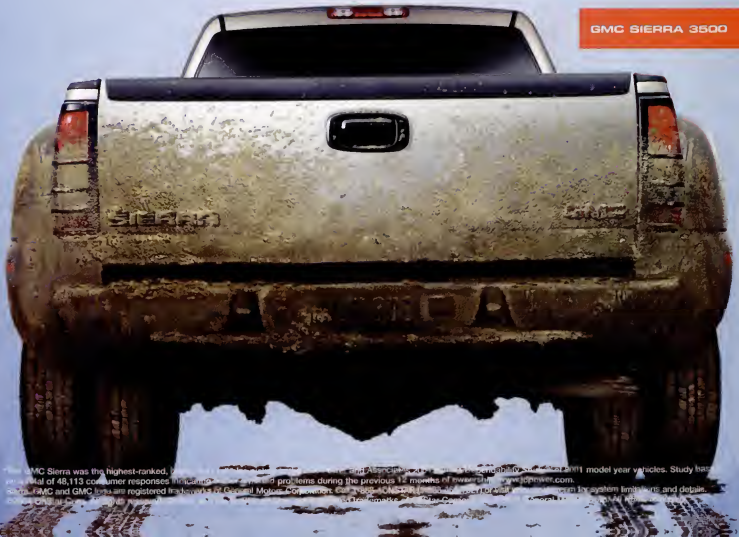
DEPENDABLE

THE GMC SIERRA HD IS THE RECIPIENT OF THE 2004 J.D. POWER AND ASSOCIATES AWARD FOR MOST DEPENDABLE FULL-SIZE, HEAVY-DUTY PICKUP TRUCK. ONCE AGAIN, IT SEEMS NOTHING IS QUITE AS DEPENDABLE AS PROFESSIONAL GRADE ENGINEERING. IT'S NOT MORE THAN YOU NEED. JUST MORE THAN YOU'RE USED TO.

WE ARE PROFESSIONAL GRADE.™ GMC®

OnStar® ONSTAR IS AVAILABLE WITH EMERGENCY SERVICES, STOLEN VEHICLE TRACKING, AND REMOTE DOOR UNLOCK.

GMC SIERRA 3500



*The GMC Sierra was the highest-ranked, ... problems during the previous 12 months of ownership ... 2001 model year vehicles. Study based on a total of 48,113 consumer responses ... www.jdpower.com.

GMC and GMC Sierra are registered trademarks of General Motors Corporation. Get the most out of ONSTAR® ... by system limitations and details.

Lubriplate®
Multi-Purpose Spray Lubricants

LUBRIPLATE

3 Great Ways To Fight Friction, Wear, Rust & Corrosion.

Chain & Cable Fluid
- Superior Non-Gumming Penetrating Oil.
- For Chains, Cables and General Lubrication.

Spray Lube 'A'
- Multi-Purpose White Lithium Grease.
- For Locks, Latches, Hinges, Slides and More.

Gear Shield Extra Heavy
- Heavy-Duty, Extreme Pressure Lubricant.
- For Gears, Slides, Jack Screws, Fifth Wheels.

LUBRIPLATE® Lubricants
Lubriplate Division / Fiske Brothers Refining Co.
Newark, NJ 07105 / Toledo, OH 43605
1-800-733-4755 / www.lubriplate.com

Available at:
CARQUEST

Never Pay High Heating Bills Again!

CLASSIC
Outdoor Wood Furnace
100% Wood Heat for Your Home, Water, Shop and More.

"Buying a Classic Central Boiler is one of the best decisions I have made... my heat and hot water cost me zero. Since installing the boiler I saved between $300 and $400 per month..."
- Don P., CT

0 DOWN AND
0 PAYMENTS FOR 1 YEAR
LIMITED TIME ONLY, OAC at participating dealers

CENTRAL BOILER
800-248-4681
centralboiler.com

Dual Fuel Option and Stainless Steel Models Available.

25 YEARS LIMITED WARRANTY

©2004 Central Boiler ad3246

Unsecured installment loans provided by EnerBank USA to homeowners who meet bank's qualifications. Loan terms vary from 24 months to 132 months based upon the amount of the loan. APR varies from 8.5% to 13.8% based upon the amount of the loan, the repayment term and creditworthiness of borrower as determined by bank. Interest rates are subject to change. Limited time offer. Deferred First Payment loan is available only through participating Central Boiler authorized dealers. EnerBank USA, 1245 E. Brickyard Rd., Suite 100, Salt Lake City, UT 84106.

won't start automatically unless I hit the reset button. It then starts right away and goes through its cycle until it's time for it to start again, which it won't do until I hit the reset button again. How can I solve this problem?

D. ARNOLD
Via Internet

There are a number of factors that could cause the oilburner to "lock out," which would require activating the reset button. A defective start switch, air in the supply line, and the quality and viscosity of the fuel oil are just a few. A technician at oilburner manufacturer Beckett told me that the company's technical service department can help. Have your regular service technician call Beckett at 800-645-2876.

Smoke Detector

I have FireX Model GC smoke detectors in my house. The detectors are all hard-wired so that if one goes off, it will activate the others. Recently they all were activated because I burned some toast. Now one of the detectors has a red light on all the time while none of the others has a red light on. Is this unit still a working smoke detector or does it need to be replaced?

JOHN W. TRUSCOTT
Via Internet

I initially thought it was possible that some residual smoke particles were caught in the detector and had to be cleaned out. However, in that case all the alarms would have been activated, which you said is not the case. So I called the people at FireX who said that the smoke detector is defective and should be replaced if the light is on continuously with no alarm sounding. When the unit is working properly the light will blink once a minute. This indicates that the detector is functioning in standby mode.

For more information on the company's products, visit its Web site: www.icca.invensys.com.

While we're on the topic of smoke detectors, a quick review of the basics is in order. All smoke detectors should

be installed per the manufacturer's directions. Battery-powered smoke detectors are sometimes installed on a wall or a ceiling at the corner where the two surfaces meet. This is incorrect because it limits the detector's ability to react to smoke. Also, change the detector's battery yearly. **PM**

BULLETIN

After The Flood (And The Fire, And The Storm, And...)

FIRE, smoke, wind and water have occupied the attention of the human race since the dawn of time. That's no less true today, especially given the damage to thousands of homes in the eastern United States during the summer and fall hurricane season. The point isn't lost on the Association of Specialists in Cleaning & Restoration (ASCR), the trade group of contractors who clean up damage from hurricanes and fires. The organization's recent Philadelphia convention examined air quality, mold and mildew, and damage from fire, smoke and water. Workshops were presented by biologists, engineers, scientists and even a conservator from the famed Winterthur Museum in Winterthur, Del. "It's an effort to bring the very best information available to our membership," says ASCR technical adviser Martin King.

Hiring a restoration contractor after a fire, hurricane or flood is no easy matter, says King. Check the contractor's professional affiliations and training. And don't overlook the obvious: Ask to speak with prior customers, he told us. Visit the ASCR International Web site for more information: www.ascr.org. *—R.B.*

Do You Have A Home-Maintenance Or Repair Problem?
Just ask Norman about it. Send your questions to Homeowners Clinic, Popular Mechanics, 810 Seventh Ave., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.

BOSCH

BETTER VISION WITHOUT A PRESCRIPTION.

Bosch Micro Edge Excel features dual rubber compound technology for the cleanest wipe and longest life. And our exclusive one-step DirectConnect™ system makes installation a snap. There's no better way to improve your vision. Call 1-888-TOP-BLADE for a retailer or visit us at boschusa.com.

© 2003 Robert Bosch Corporation.

AUTO CLINIC

BY MIKE ALLEN

IT'S GOING SOMEWHERE

We have an Olds Alero with the 3400 V6 and 93,000 miles. My wife said the oil light came on when she was driving. I checked—the oil was over 2 quarts low, after only about 4000 miles. I changed the oil and now the oil consumption seems to be about three-quarters of a quart after 1000 miles. The dealer claims that GM says 1000 miles per quart isn't an abnormal amount of oil to consume. *–Luther Burrell Kosciusko, MS*

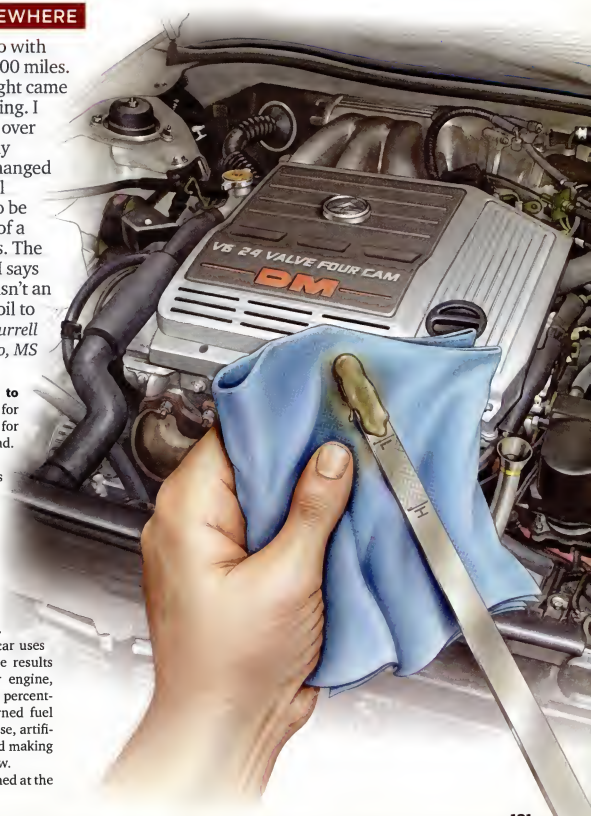


ILLUSTRATION BY DON MANNES

FIRST off, I'm going to give you a hard time for not checking the oil for 4000 miles. Bad driver, bad. Consider yourself chastised.

General Motors does maintain that 1000 miles per quart is an acceptable rate of oil consumption. I agree. Some oil needs to get into places in the engine from which it can't return, notably above the top ring and down between the valve guide and valve stem. Anybody who claims their car uses no oil at all hasn't seen the results of an oil analysis on their engine, which probably shows a fair percentage of moisture and unburned fuel accumulating in the crankcase, artificially raising the oil level and making the oil consumption seem low.

But you should be concerned at the

sudden change in trend. I'd look carefully for a leak associated with the air cleaner, or a failed air filter that's allowing airborne dirt to enter your engine. The abrasive dirt will wear out rings and valve guides rapidly.

And, remember that oil that's escaping from the crankcase into the combustion chamber will enter the catalytic converter and be burned. Used to be that this oil followed you along the road as blue smoke, telling the world you had bad rings. No longer. So check your oil every few weeks.

Dot Confusion

I am planning on redoing the brakes on my 1987 Chevy S-10 soon. I noticed that the brake and clutch caps are both labeled "USE ONLY DOT 3 BRAKE FLUID," and I can't say I've ever seen that before. I thought that if DOT 3 were specified, DOT 4 was permitted. The only difference is the boiling point, so why not?

TOD LABRIE
Boston, MA

You should stick to a brake fluid that meets DOT 3 specifications. DOT 3 fluid uses a glycol ether base—chemically similar to antifreeze—and an additive package of anticorrosion

CAR CARE TIP

SAE Or Metric

THE oil filter had blown clear of the threaded oil filter adapter on the side of the engine a few seconds after the engine had been started. The owner insisted that he had used the correct filter for the Mitsubishi engine in his Chrysler minivan. I found two different filters listed for that engine—one with 3/4-16 standard threads for Chrysler applications, and another with 20mm threads for Mitsubishi-branded products that used the same V6. Since 20mm is larger than 3/4 in., the filter blew off on a cold morning when the oil was thick. Check the threads on your filter adapter with a 3/4-in. open-end wrench. If it fits over the threaded portion of the adapter, you have 3/4-in. threads. If not, they are 20mm.

ILLUSTRATION BY ADOLPH E. BROTMAN

WeatherTech®
Automotive Accessories
CLASSIC™
Premium Rubber Mats
Available in Black, Tan or Grey
ClearCover™
WeatherFlectors™
WeatherFlectors™ applications to fit over 600 vehicle models!
See Everything at mats.com
Cargo Liners
Applications for virtually any vehicle!
ADVANTAGE™
Luxury Carpet Mats
Cargo Liner applications to fit over 900 vehicle models!
MacNeil AUTOMOTIVE PRODUCTS LIMITED
800 441-6287
MacNeil Automotive Products Limited • 2435 Wisconsin Street • Downers Grove, IL 60515 • 630-769-1500 • fax 630-769-0300

SERVICE TIPS

■ Does the 4.7-liter engine in your 2002 Dodge Ram fluctuate at idle? Technical Service Bulletin (TSB) 18-036-03 details how to reprogram the Powertrain Control Module with revised software to correct the fluctuation.

■ Is there a sloshing noise in the fuel tank of your 2002-03 Nissan Altima when the tank is full or when you're braking or going over bumps? TSB NTB02-103a has a fix that involves shim pads for the tank, insulation under the rear seat and new baffles for inside the tank.

■ When it's raining, does the flip-up rear glass on your 2003-04 Jeep Liberty or Cherokee keep opening all by itself? TSB 23-002-04 says to keep the door locks locked, or better yet, replace the swing-gate handles.

compounds. It will eventually absorb some moisture from the atmosphere, largely by diffusion through the rubber hoses in the system, as well as some from the reservoir. Moisture causes two problems: a reduced boiling point and corrosion in the system's interior.

DOT 4 fluid uses a different chemistry, specifically a borate ester base, and has a higher boiling point than DOT 3 fluid. It also absorbs moisture, which degrades its boiling point. It is incompatible with some older cars' (much older than your S-10) rubber lines and seals. DOT 3 is less viscous than DOT 4, and may be more suitable for antilock brake systems, as less air should be trapped in the pump. One source I found says DOT 3 is more compatible with some types of rubber seals over long periods.

Why did GM specify only DOT 3? Hard to say. It's more than adequate for the kind of brake temperatures you'll see driving around on the street. Race applications may require the slightly higher boiling point of DOT 4 fluid. And at least one manufacturer (Valvoline) makes a fluid they say is compatible with both the DOT 3 and DOT 4 standards, which I'm sure will confuse people for years to come.

I'll also briefly touch on silicone-based DOT 5 fluid. It was more popular a few years ago, but its incompatibility with DOT 3 and 4 fluids, and spongy brake feel and inability to disperse water through the system have made it fall out of favor. I don't recommend it. **PM**

Do You Have a Car Problem?
Just ask Mike about it. Send your questions to Auto Clinic, Popular Mechanics, 810 Seventh Ave., New York, NY 10019. While letters, faxes, phone calls or e-mail cannot be answered individually, problems of general interest will be discussed in the column.

DO IT YOURSELF.
BRAG TO EVERYONE ELSE.

Find the trusted quality of
Stanley® Mechanics Tool Sets at Wal-Mart.

Available in 62-, 96-, 122- and 151-piece sets, these professional-grade tools are perfect for any job, big or small. And you can fix what's broke without going broke because these exceptional Stanley tools are always available at Wal-Mart's Every Day Low Prices.

STANLEY

WAL★MART
ALWAYS LOW PRICES.
Always

© 2004 WAL-MART

SATURDAY MECHANIC

BY PAUL WEISSLER

Turn Up Your Heater

IT'S colder than a witch's belt buckle outside, so you gulp down some hot coffee, dash to the car, start the engine and run inside. Although you know engine idling isn't a great way to warm up an engine, comfort counts most on a cold morning. Once embarked on your morning commute, you turn the heater control up to Hot and flip the blower switch. The effect of the hot coffee has worn off, but you're not getting enough heat from the floor registers to make up for it. In fact, the windows start to frost over.

Your heater system is underperforming. You plan to tear into it as soon as you can get the car into a heated garage.

First step: Confirm the problem by driving long enough to warm up the engine. Turn the heater control to Hot, select the floor mode and set the blower to medium/high speed. Make sure there's strong airflow from the floor registers. Check the temperature with a thermometer inserted into the driver's and passenger's registers. Although many vehicles deliver a toasty 135° to 155°, 115° to 120° is acceptable. If the air temperature is okay but airflow is weak, the problem is the blower or a dashboard ductwork problem.

DEGREE OF DIFFICULTY

DIFFICULT

Heater register temperatures not even close to 115° to 120°? Check factory service bulletins to see if there's a known problem (at the vehicle maker's technical service Web site or at www.alldatadiy.com). If nothing applies, do an underhood inspection.

■ The coolant level in the reservoir (and radiator if it has the pressure cap) should be at specs. The coolant should look clean and have been regularly changed within the

Dangle the thermostat in hot water while you monitor the temperature. The 'stat will drop off as the water rises above the 'stat's actual (rather than rated) actuation temp. Too cold, and your engine never properly warms up.

ILLUSTRATION BY DON MANNES

(Please turn to page 126)

advertisement

PARENTS' CHOICE RECOMMENDED
Parents' Choice Foundation

Popular Mechanics for kids™

THE POPULAR TV SERIES NOW AVAILABLE ON DVD AND VHS!

The science behind all the fun!

Encourage your child's inquisitive mind with the award-winning POPULAR MECHANICS FOR KIDS series, now on DVD and VHS! Follow kids hosts Jay, Elisha, Vanessa and Tyler as they travel the U.S. and Canada on a never-ending quest to find out how things work!

Available Now

SLITHER & SLIME
AND OTHER YUCKY THINGS
includes episodes: Garbage, Creepy Crawlers, Underground and Slimy & Slithery

&

RADICAL ROCKETS
AND OTHER COOL CRUISING MACHINES
includes episodes: Submarines, Cool Cars, Boats and Spaceships

More Titles Out Soon!

amazon.com

www.popularmechanics.com

© SBA Productions, Inc., a Crescent Group Company. 2004 NOCH Vision LLC - All Rights Reserved - Popular Mechanics for Kids is a trademark of Hearst Communications, Inc. - All Rights Reserved - kochvision.com

specified interval. If it's been neglected, all bets are off.

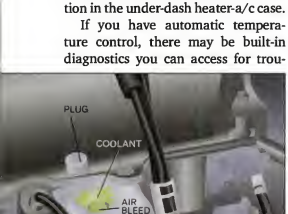
■ Cabin heat comes from hot coolant, so drive long enough to warm up the engine. The coolant temperature should hit at least 160°, preferably 180° to 220°.

■ The air conditioner compressor should be disengaged with the climate control selector out of the defrost position. If it's engaged, there's an a/c circuit problem.

■ If coolant temperature is acceptable, feel both heater hoses, which should be hot. They are? Check the temperature-control flap-door operation in the under-dash heater-a/c case.

If you have automatic temperature control, there may be built-in diagnostics you can access for trouble codes covering the temperature control door. (Refer to a service manual, factory tech service Web site or www.alldatadiy.com.) On many cars you can watch the temperature-door motor and shaft operation by removing an under-dash panel and/or lowering the glovebox. (Here again, you'll have to check a manual or Web site for instructions.) If you don't see and/or feel the motor or flap-door shaft operate as you change the temperature reading, you've pinpointed the problem. In many cases, the flap-door shaft breaks and the assembly must be replaced, but the motor is good and can be reused.

Check for good vacuum supply to the heater's control valve. If it's good, check the valve itself for proper operation.



Remove or open any air bleed plugs on the block or heads while refilling the engine to purge any air in the system.

Simply blocking the radiator can make your car warm up faster in extremely cold weather.

On econocars with manual a/c, the temperature flap may be controlled by a cable from the dashboard lever or knob. Operate it quickly in each direction and listen for a soft slam against a stop. If you feel binding, the cable is kinked or the flap is jammed. Total free play? The cable is loose or disconnected, or the flap is broken.

Nothing's obviously wrong? There may be air pockets in the cooling system—these commonly develop over time. If there's a pressure cap on the radiator or engine and a low coolant level in the radiator, but the level in the reservoir is normal, a defective gasket in the cap is admitting air. Replace the cap.

Top up the system and purge air, following the vehicle maker's specific procedure.

As a generic approach, start with the engine cold, all bleed valves open, and the side of the vehicle with the coolant neck jacked up as high as possible. This raises the fill neck to the high point, so air bubbles out. Slowly add a 50/50 antifreeze/water mixture to the fill neck. You'll see some coolant (and perhaps air bubbles) oozing out of the bleeders. Close the bleeders, refit the pressure cap, and run the engine at about 2500 rpm until it's warmed up (or as warm as it will get). Allow the engine to cool down, then repeat the top-up procedure. You may have to repeat this every few days over a week to get most of the air out.

Coolant temperature too low? On vehicles with a clutch-type fan on the engine, make sure the clutch is not locked up. Spin it by hand (with the engine off but warmed up). If there's virtually no slippage, the clutch is defective. If it spins two to three times, it's probably okay.

Could someone have removed the thermostat, probably trying to remedy an overheating situation? That's a very bad idea, not to mention the fact that it is illegal to tamper with emissions controls.

No fan operation problem and coolant temperature is very low? If you've neglected your system, the thermostat might be stuck open from debris. If it's really buried, pour in a cooling system cleaner and run the car per the instructions. Then, do a triple drain-and-refill of the radiator and engine block, and go through the air-bleeding top-up process. If coolant temperature remains low, bite the bullet and remove the thermostat for a test.

If the access to the 'stat isn't bad, hold off on the drain-and-refill, and pull the 'stat for a look and a test.

(Please turn to page 128)

ILLUSTRATIONS BY RON CARBONI

ENHANCE YOUR

LOVE LIFE

NATURALLY, SAFELY AND PERMANENTLY.

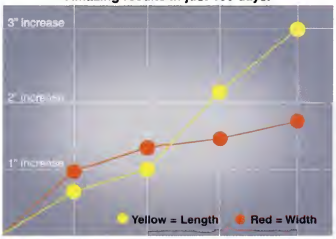
A quality cologne doesn't hurt. An enthusiastic technique will earn you style points. But when push comes to shove, size matters. Big time.

EXTRA™ will give you the impressive size you've always wanted. Quickly and naturally. Without useless pumps, painful surgery or silly exercises. Guaranteed!

Order our recommended 180 day supply of Extra and receive a FREE tube of Extra Gel, our revolutionary enlargement gel. This is a value of $89.95, absolutely FREE.

EXTRA contains a clinical strength, revolutionary herbal formula that pumps up your body's own hormones to stimulate growth and development. When taken for a short period of time, you can expect eye popping gains of one to three inches in length and a 50 percent increase in thickness. The results are guaranteed.

Amazing results in just 180 days.



Extra has no side effects, however, some men may show signs of increased sexual appetite or desire. Extra contains pharmaceutical grade ingredients and no longer requires a prescription.

We've sold more than a million bottles of EXTRA and helped enhance the love lives of hundreds of thousands of men and women. We can help you, too!

If you think it only takes a big diamond to win her heart, think again.

Order EXTRA today.
1-800-558-7799

EXTRA™
(AVENA SATIVA)

Order Form (All orders are confidential and discreetly packaged.)

Please mail this form with your check or money order, payable to:

G.P.I. Direct
3645 Marketplace Blvd. #130-255
East Point, GA 30344
1-800-558-7799

Name_____

Address_____

City_____ ST____ Zip_____

Telephone Number_____

Credit Card Number_____

Exp Date_____ ☐ Visa ☐ MC ☐ AmEx ☐ Discover

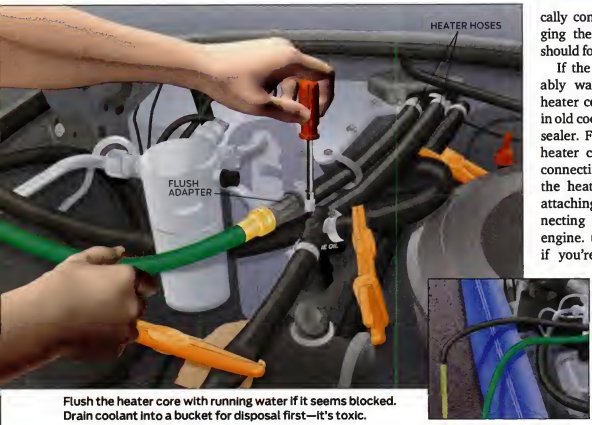
☐ Check or money order enclosed

Signature_____

Please send me:
☐ 30-Day Supply.....$62.90
☐ 60-Day Supply.....$115.80
☐ 90-Day Supply.....$168.70
☐ **180-Day Supply....$327.40**
(With our recommended 180 day supply, receive a FREE tube of EXTRA Gel)

Prices including Shipping & Handling
Total Enclosed $_____

© Global Pharmaceutical Institute



Flush the heater core with running water if it seems blocked. Drain coolant into a bucket for disposal first—it's toxic.

Clean if necessary, but before putting it back refit the 'stat housing, then run a cleaner through the system. Then do the triple drain-and-refill, and test the thermostat before you decide to reinstall.

Testing: Wedge a 0.002-in. feeler between the closed 'stat valve and its seat, then submerge the 'stat in a pot of water on a stove. Rest a radiator thermometer in the water, heat the water to boiling, and note the temperature at which the thermostat cracks open—it will drop off the feeler at its rated temperature.

Some engines, particularly transverse four-cylinders, radiate so much heat so fast that there's no internal fix for extremely cold weather. It may not be an elegant solution, but put a piece of cardboard against the front of the radiator, blocking about half of the surface area. Trim it back if the engine starts running hot. Remember to remove the cardboard in the spring.

Coolant temperature reading is normal, but one or both hoses are not hot? Refer to a service manual or Web site to identify the heater inlet versus outlet hose.

Neither hose is warm? Many cars have a heater coolant shutoff valve spliced into the heater inlet valve for better a/c performance in summer. If the shutoff valve fails to open fully, the flow to the heater will be restricted. Vacuum operated? Disconnect the hose. If you feel vacuum (with some valves you'll also see the linkage move), the valve is being held open by a defective vacuum control. Leave the hose disconnected (plug the end with a golf tee) and see if that cures the problem. If it doesn't, the shutoff valve is stuck. Replace it. If the valve is cable controlled, you should see the valve shaft move continuously as the dashboard temperature lever is operated. If it doesn't or if it moves just slightly, the cable needs adjustment. Note: The VW Golf and Jetta have a cable-type valve, but it opens proportionally to the flow of hot coolant as needed—there are no flaps in the dash.

On some other European cars and on the Lincoln LS, the valve works similarly to the VW's, but it's electronically controlled. Quick test: Unplugging the electrically controlled type should force the system to full heat.

If the heater inlet hose is noticeably warmer than the outlet, the heater core is restricted from debris in old coolant or from excessive use of sealer. First, try to reverse-flush the heater core. Do this by either disconnecting both heater hoses from the heater necks on the cowl and attaching spare hoses, or by disconnecting both heater hoses at the engine. (Clamp off the heater hoses if you're using spare hoses; plug the engine hose necks if you're disconnecting there.) Force a garden hose into the heater outlet hose, aim the inlet hose away from the vehicle, and open the bibcock. If the debris flows out and you eventually see a healthy flow of coolant, you may have caught a break. Otherwise, you've got to replace the heater core.

If heater performance during highway operation is all right but it really drops off in low-speed driving, there's a cooling system flow problem. Some systems have a hose restrictor in the inlet hose, and if it gets plugged with debris, that lowers the flow. You should find this by feeling along the inlet hose with the engine idling. (You'll reach a section where the temperature significantly drops.) A few engines (on the Dodge Durango, Lincoln LS and a number of German cars) have auxiliary water pumps to improve coolant flow at low speed/idle. If the pump fails, heater output drops during that operation. Of course, if the cooling system was long neglected, it's possible the engine water pump has eroded internally, reducing coolant flow.

In most cases, poor heater operation can be cured by following the factory top-up procedure with the air bleeds open. Do this several times over the course of a week. Is there a faster fix? A pro with a coolant changer that purges air as it fills the system can give you faster heat. PM

For more automotive features check out the PM.Zone Web site
POPULARMECHANICS.COM/AUTO

ILLUSTRATIONS BY RON CARBONI

A DEAL TOO TOUGH TO PASS UP.

Get a $400 Warn Winch for just $69.95 PLUS as low as $39 per month @ 3.9% APR for 24 months.*

2500 lb. Warn Winch/Plow offer available through participating Yamaha dealers only, Sept. 1 2004 - Dec. 31 2004, and good on all new 2005 (or new prior year) Grizzly 660 4x4, Kodiak 450 4x4, Kodiak 400 4x4, Big Bear 400 4x4, Bruin 350 4x4, Kodiak 400 2WD, Big Bear 400 2WD, and Bruin 350 2WD. Dealer participation may affect this offer. Installation not included.

*Finance offer available at participating Yamaha dealers on the Yamaha card, subject to credit approval, 9/1/04 - 12/31/04, on any new 2005 (or prior year) Yamaha Motorcycle (excluding FJR models), ATV, or Scooter model. Reduced Rate 3.9% APR and $39 monthly payment effective on these purchases for 24 months, if your Account is kept current. Maximum amount financed $10,000. For amounts of $10,001 to $20,000, $69 monthly payment for 24 months will apply. Thereafter, the Standard Rate 9.99%, 13.99%, 17.99%, or 21.99% APR will apply and minimum monthly payments will be required as described in your cardholder agreement. For Accounts not kept current, the Default Rate 24.99% will be applied to all balances. Minimum Finance Charge $1.00. Certain rules apply to the allocation of payments and Finance Charges on your promotional purchase if you make more than one purchase on your Yamaha card. Call 1-888-367-4310 or review your cardholder agreement for information.

ATVs with engine sizes of 90cc or greater are recommended for use only by riders age 16 years and older. Yamaha recommends that all ATV riders take an approved training course. For safety and training information, see your dealer or call the ATV Safety Institute at 1-800-887-2887. ATVs can be hazardous to operate. For your safety: Always avoid paved surfaces. Never ride on public roads. Always wear a helmet, eye protection and protective clothing; never carry passengers; never engage in stunt riding; riding and alcohol/drugs don't mix; avoid excessive speed; and be particularly careful on difficult terrain. For the Yamaha dealer nearest you call 1-800-88-YAMAHA. **yamaha-motor.com**

YAMAHA

DESKTOP ORGANIZATION

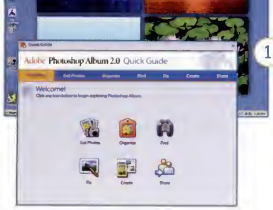
Mega-Pics Mastery

The solution to photo overload. **BY STEVE DITLEA**

IT'S only after scrolling down a list of hundreds of JPEG files with numbers for names that one understands the dark potential of a digital camera to generate chaos. Save money on film? Sure. Delete the worst shots as you go? If you're disciplined. Organize your pictures efficiently? Well, that takes a bit of know-how. The fact that they're not paying for film seems to bring out the artist in some people, causing them to take more shots than needed. So while it may just be a good idea to organize prints into albums for the shelf, eventually it becomes really necessary to create computerized albums.

This can be fun. The results might include all kinds of nifty slide shows and formatting. Then, instead of sharing your pix with one hapless visitor at a time, you can burden an entire mailing list of folks with the complete work, all at once.

Many software packages can create albums, as can a number of online services (see sidebar at right). An excellent example is Adobe's Photoshop Album 2.0—a popular program that may have come with your computer if you have Windows XP. (It doesn't work with Macs.) If you don't already have it, the program is readily available at most software outlets for $49. Read the following steps on creating and e-mailing an album even if you're working with another program. Chances are, the procedure will be much the same.



1

GET ANNOYED...

At your messy PC desktop, that is. Then, start up Photoshop Album (the appropriate icon is on your desktop or in the Start menu) and, when the program's Quick Guide menu appears, select Get Photos.

DIGITAL PHOTO-SHARING ALTERNATIVES

Opportunities for sharing digital snapshots can be found just about anywhere you can click a mouse. Here are some other ways to share your digital images.

FREE WITH EQUIPMENT

If you use Microsoft Windows XP, the My Pictures folder lets you view photo albums, create slide shows and order prints online. Other programs often bundled free with PCs let you create albums and slide shows. PowerPoint, the Microsoft Office presentation module on most business systems, is good at creating fancy transitions between images. Check out the software discs accompanying your digital camera or computer printer. These often include a manufacturer's program suite for storing, editing and sharing picture files.

FREE ON THE WEB

There are many free photo-sharing sites to choose from, including Sony's ImageStation.com, with advanced photo-editing and special-effects capabilities, and Shutterfly.com. Kodak's Ofoto.com is notable for its easy-to-follow directions. All of these sites pay the bills by selling prints, cards and other merchandise.

PAY WEB SITES

Also consider the advantages of paid online photo-sharing sites: better album formatting, storage for thousands of photos, the ability to control downloads and send hi-res photos (good for professional applications). Funtigo Deluxe ($7.99 a month for 1000 pictures) features easy drag-and-drop placement of photos in albums and flexible page formats. SmugMug ($29.99 a year; the Pro version is $99.99 a year) provides numerous presentation styles and easy uploading.

ILLUSTRATION BY PETER HOEY

(Please turn to page 132)

For the best time of your life

Technology creates greatest advancement in time keeping since the quartz movement... and lets everyone benefit from United States Government innovation. With the Atomic Digital Watch by La Crosse Technology, all of us have the opportunity to take advantage of our tax dollars at work, in a way that will positively impact our daily lives.

How can a watch possibly create such an opportunity? The U.S. Government National Institute of Standards and Technology (NIST) Time and Frequency Division, a division of the U.S. Department of Commerce, maintains the cesium atomic clock, a clock that is accurate to within one second in a million years, to monitor and maintain the official U.S. time standard. In Colorado our government relies on the cesium atomic clock to create a national time standard to provide the most precise and accurate measure of time. The cesium clock drives a low frequency radio signal, known as the WWVB signal, which is transmitted at 60 kHz to your location at the speed of light.

The Atomic Digital Watch has a built-in receiver that automatically tunes in to the WWVB signal transmitted to the NIST stations on a daily basis, so that you can have the most accurate time in the world on your wrist! Imagine never having to worry about setting the time on your watch. Turn the watch on, select your time zone and the watch will set itself overnight. This watch will also automatically adjust for Daylight Saving Time (DST) and leap year. There is also a DST disabling feature if you live in Arizona or Indiana. With features that include a day/date calendar, 12/24 hour mode choice, signal reception indicator, adjustable band and 3-volt lithium battery, this watch is a great gift for anyone who needs to know the right time, all the time.

An unbelievably new low price.
The Atomic Digital Watch by La Crosse Technology is now available at a new low price. Originally $69.95, one of the most technologically advanced watches in the world is now available for the unbelievably low price of $39.95! Innovative Home Products home trial allows you to try the Atomic Digital Watch for 30 days risk-free. If you are not completely satisfied, simply return it for a full refund of the purchase price.

FREE WITH PURCHASE!

Order today and receive, FREE OF CHARGE, La Crosse Technology's Atomic Digital Alarm Clock with a retail value of $29.95!

- Atomic radio-controlled time
- Automatically sets time
- Time alarm with snooze
- Backlight for easy viewing

CALL NOW TO TAKE ADVANTAGE OF THIS INCREDIBLE OFFER!

Atomic Digital Watch
~~$69.99~~ **$39.95** + S&H

Atomic Digital Alarm Clock
~~$29.99~~ **FREE** + S&H

A $99 value for only $39.95!!

Promotional Code ADW-Z144
Please mention this when you call.

866-607-8738

To order by mail, please call for details.

INNOVATIVE HOME PRODUCTS

Call toll-free 24 hours a day **866-607-8738**

DISCOVER NOVUS VISA MasterCard American Express

www.InnovativeHomeProducts.com

The Toughest Glue On Planet Earth

Bonds:
Wood, Stone, Metal, Ceramic, & More!

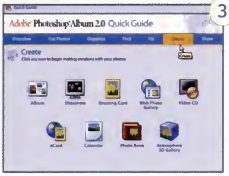
Gorilla Glue is the versatile, interior/exterior adhesive ideal for most household fixes and building projects: furniture repair, crafts, woodworking, and general repairs around the house. **Bonds wood, stone, metal, ceramic & more! Incredibly strong and 100% waterproof.**

REQUEST YOUR FREE INFORMATION KIT!
www.gorillaglue.com
1-800-966-3458

2

PICK YOUR SHOTS

On the next menu screen, select the source of your image files: hard drive, camera, scanner, file folders, CD or mobile phone. Follow the menus to specify image file names and create folders for them. Hit Import. Take advantage of the software's editing functions, if you like, before going on to work on the album itself.



3

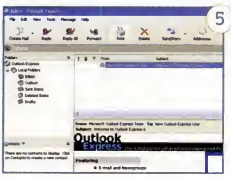
PUT IT ALL TOGETHER

On the Quick Guide menu, click on Create, and then select Album. The Creations Wizard menu prompts your choice of album style. At the following screen specify your album's title and the number of photos you want per page. The next Creations Wizard screen allows you to pick the photos to include. Then, you can make final adjustments and see a preview.

4

SAVE YOUR CREATION

The last Creations Wizard screen asks you to save your album with a name, and offers five output options. To share the album, click on E-mail. Then, choose an e-mail program and select Optimize for Viewing Onscreen to shorten download times, or Optimize for Printing to create sharper hard copies. When you're finished, the program will tell you how long it should take to transfer your album at a rate of 56 kilobits per second.



5

SHARE YOUR WORK

Continue in your e-mail program as you would when sending out any message with an attachment. Then fire it off—and take more pictures. PM

PlasmaCAM Inc.

PO Box 19818
4932 Graneros Rd. Unit B
Colorado City, CO 81019
(719) 676-2700
fax (719) 676-2710
www.plasmacam.com

Cut Precise Metal Shapes In A Flash!

- Make Artistic Projects and Mechanical Parts
- Do Detailed Custom Work or Mass Production
- Includes Digital Height Control™
- Includes Industry-Leading Software and Electronics for Plasma Cutting
- Simple to Operate – Runs off Your Personal Computer

"We used to cut everything by hand and had a lot of trouble. Now our PlasmaCAM does it all, attaining levels of production not possible before. It's run 40-50 hours a week for the past three years. It attains incredible detail, is very easy and cost efficient to operate, and requires little maintenance. The bottom line is: *this machine makes me money!*"

~JON
Restaurant Lighting & Fixtures

"PlasmaCAM is a well thought-out tool. The software is incredible. I can quickly go from a concept to a finished part. I haven't seen anything we can't do with this machine. It's saved us so much time and effort, it's just incredible!"

~JIM
Custom Turbo Engineering

Greatly expand your capabilities! Call today for your free demo video and see why PlasmaCAM™ is the world's best selling CNC plasma cutting machine!

(719) 676-2700

COURAGE AFTER FIRE

(Continued from page 93)

"Whatever it takes to save Kevin," Amanda agreed. On June 20, Father's Day, Kirk removed Pannell's legs.

The next day the medical team brought Pannell out of his eight-day sleep. "The doctor told me that my left leg was gone above the knee, and the right one below the knee," Pannell recalls. "I told him, 'Well, I guess I can live with that.'"

During the Vietnam era, military doctors usually closed combat wounds in theater. The current strategy is first to perform multiple cleansing procedures to avoid infection. Pannell's post-amputation tally: eight more operations to remove dead and damaged tissue and foreign matter before the skin flaps were finally sutured. "These wounds [coming out of Iraq] are so bad because they're infected with *Actinobaccillus*," Kirk says. This bacterium occurs in deserts worldwide, but in the past 18 months physicians have discovered the type found in Iraq is especially virulent. It's now standard procedure to administer intravenously antimicrobial drugs like amikacin to the wounded.

Pannell looked forward to those operations. "I couldn't sleep when I first got to Walter Reed," he says. "I'd have nightmares about the ambush and live it all over again. With the surgeries at least I could sleep for a few days."

SITTING IN HIS wheelchair along one side of the physical therapy clinic, Pannell looks characteristically intense as he pulls a liner made of an adherent silicone composite over his residual left thigh. A 2-in. titanium pin is screwed to the bottom of the liner. Pannell inserts it into the socket on the transfemoral (midthigh) prosthesis and, with support from his physical therapists, stands up.

Once Pannell has steadied himself, the therapists guide him between a set of parallel bars. Dennis Clark, the owner of Orthotics and Prosthetics One, of Waterloo, Iowa, plugs a connector from his laptop into a port in Pannell's artificial knee and begins to take readings. In August 2003 the Walter Reed staff realized they needed help in managing the influx of lower-limb amputees from Iraq and Afghanistan, so they called on Clark, whose company customizes the C-leg. (The C refers to the programming language used in the prosthesis.) Introduced in the United States in 1999, the C-leg replaced the "swing-and-stance" hydraulic-resistance leg that dates back to the Vietnam era. "The SNS was fantastic for 30-plus years," says Clark. "Now we've got new technology."

The programmable C-leg contains on-board microprocessors and a sensor pylon, which are used to control the limb's hydraulics. Prosthetists evaluate how amputees climb steps, walk up and down inclines, and navigate uneven ground, then program

(Please turn to page 136)

Save up to $80 on the BELL+HOWELL Sunlight Lamp!

Enjoy sunshine every day of the year-indoors!

CLEARER, BRIGHTER, EASY ON THE EYES NATURAL LIGHT
FOR READING, WORK, AND HOBBIES
COLORS LOOK MORE VIVID AND TRUE TO LIFE
SHARP VISIBILITY FOR DETAILS
HELPS REDUCE EYESTRAIN

So much like sunshine it feels like you're on vacation!
The Bell & Howell Sunlight Lamp could be the most important advance in lamps since the invention of the light bulb! It simulates outdoor sunlight, which is balanced across the entire spectrum of color visible to the human eye.

Everything seems easier to see
This is the clearest, whitest, and brightest lamp we have found. Colors look more vivid and true to life. It's the perfect light for reading, working and all close up tasks and hobbies. There is virtually no glare, making this the perfect companion light for computer work.

Save $$$ on your electric bills!
The supplied high-tech 27-watt bulb gives as much light as an ordinary 150-watt bulb, but uses far less energy. The bulb can last up to 5000 hours - 5 times longer than other bulbs—for years of normal use.

We've nicknamed our Sunlight Lamp the "It's great to be alive lamp!"
Many people say that dreary, dark days make them feel "blue" and that bright sunny days have a cheerful and energetic effect. Now you can switch on the sunlight indoors every day of the year!

Was $99.95 $69.95 NOW ONLY $49.95 EA.

Table Lamp Only $49.95

A word about this unheard of price
Bell & Howell has been a leader in developing cutting edge products for almost 100 years. This lamp features the state-of-the-art performance you expect from the well-respected Bell & Howell name. We have a special arrangement to offer it to you at an unbelievably low price. Orders will be filled on a first come, first served basis.

With ordinary lamp

Get your floor lamp home for just $16.65!
If you choose the 3-payment plan, we will ship you the floor lamp with your first payment of $16.65 plus shipping and handling. After that we'll bill you $16.65 once a month for two additional payments. **3 year warranty.**

BELL+HOWELL

Call toll-free TODAY to order your Bell & Howell Sunlight Lamps while supplies last!
Floor Lamp (60.5"high): $49.95 plus S&H
Table Lamp (26"high): $49.95 plus S&H
For fastest service call toll-free
1-800-838-1237
24 hours a day, 7 days a week / We accept checks by phone!

Bell & Howell Sunlight Lamp, Dept. 4687
P.O. Box 5555 Thousand Oaks, CA 91359
To order by mail please call toll free
1-800-838-1237 for details.

The fastest way to learn a language. Guaranteed.™

Finally, a different approach that has millions of people talking. Using the award-winning Dynamic Immersion™ method, our interactive software teaches without translation, memorization or grammar drills. Combining thousands of real-life images and the voices of native speakers in a step-by-step immersion process, our programs successfully replicate the experience of learning your first language. Guaranteed to teach faster and easier than any other language product or your money back. No questions asked.

Spanish (Latin America or Spain)	**French**	**German**	**Japanese**	**Thai**	**Arabic**	**Turkish**	**Polish**	**Swedish**
English (US or UK)	**Italian**	**Russian**	**Indonesian**	**Korean**	**Hebrew**	**Danish**	**Welsh**	**Pashto**
	Portuguese	**Chinese**	**Vietnamese**	**Hindi**	**Greek**	**Swahili**	**Dutch**	**Latin**

Award-winning software successfully used by U.S. State Department diplomats, Fortune 500 executives and millions of people worldwide.

Step-by-step immersion instruction in all key language skills:

Listening - The Rosetta Stone uses native speakers and everyday language to develop your understanding of the spoken language naturally and easily.

Reading - Text exercises develop your reading skills by linking written language to real-life objects, actions and ideas.

Speaking - Speech-recognition feature records, diagrams and compares your voice to the native speaker's, grading your pronunciation.

Writing - Dictation exercises evaluate your spelling, syntax and punctuation.

"...your program is the absolute best, bar none. I am shocked at how quickly I learn."

- Michael Murphy, Texas, USA

"Stupendous...the juxtaposition of text, sound and picture was masterful. The quality of both sound and graphics was first rate."

- The Boston Globe

Each fully interactive course includes:

- CD-ROM curriculum with 12 activities in each of 92 lessons
- Previews, comprehensive exercises and testing for each lesson
- Automated tutorials that "learn" where you need extra help
- Curriculum Text and 45-page User's Guide

Save 10%

Level 1 Program	Level 2 Program	Level 1 & 2
Regularly ~~$195.00~~	Regularly ~~$229.00~~	Regularly ~~$329.00~~
		BEST VALUE!
Your Price **$175.50**	Your Price **$202.50**	Your Price **$296.10**

Personal Edition. Solutions for organizations also available.

Call today or buy online for a 10% discount:
RosettaStone.com/pms124
1-888-232-4871
Use promotional code pms124 when ordering.

RosettaStone®
Language Learning Success

(Continued from page 134)

the leg to imitate the patient's locomotion. The microprocessors in the knee make up to 50 calculations per second to ensure the patient is safe and stable. Despite its sophisticated circuitry, the C-leg isn't built for running, which would overheat the microprocessors. If amputees want to run, they use a specialized metal and carbon-fiber running leg.

Clark takes more alignment and resistance measurements, then signals for one of the therapists to guide Pannell around the room. Following alongside, Clark takes base line calibrations on the soldier's rocking walk. Human locomotion and anatomy put a person's center of gravity in a 2-in. cube near the navel. The more the center of gravity moves out of that sweet spot, the harder it is to walk. Clark is attempting to align the artificial leg's flexion and extension hydraulics to complement Pannell's gait and keep the center of gravity as close to normal as possible.

After the circuit, the therapists put Pannell through a rigorous workout—leg raises, crunches, push-ups. Marine Cpl. Dan Lasko, also recovering from wounds suffered in Afghanistan, performs extensions on his left lower-leg prosthesis at a nearby exercise station. He grins at the sweating Pannell. "Look tough," he barks.

THE HOSPITAL'S smoking section is a row of benches about 6 ft. from the Greyhound buses idling near a side entrance. When Pannell and Lasko wheel themselves outside, the benches there are filled with combat-wounded smokers—some in wheelchairs, some wearing prosthetics, some whose injuries aren't so obvious. So the two men roll a few yards down the sidewalk to the nearly empty non-smoking benches.

Looking relaxed, Pannell lights up a Pall Mall just as a large woman in a red dress shuffles past. "This is the non-smoking section," she grumbles. Pannell takes a deep drag, exhales, and then winks at his buddy. "I didn't feel like walking," he says. Lasko chimes in. "Lady, give us a break. We're cripples."

Pannell and Lasko talk about Iraq, but not about battles or wounds suffered. Lasko wonders why the media "covers only the negative stuff." Pannell agrees. "They don't talk about the good we do, the schools and clinics we rebuild."

Then Pannell's talk turns, as it often does, to his platoon, which will finish its tour of duty in February. "They still see me as bedridden," he says, "but I go to physical therapy and occupational therapy every day. My war is over. They're still in the middle of it."

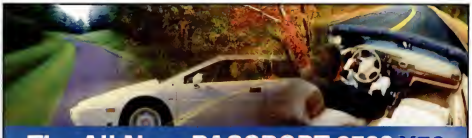
He has good reason to worry. On Aug. 12, Bradley Lawing, the medic who saved Pannell's life, was injured by a grenade just a few blocks from where Pannell was wounded. The

(Please turn to page 139)

Popular Mechanics PM.ZONE 57

Go digital now.

Log on to popularmechanics.com



The All New PASSPORT 8500 X50

"It might be the best radar detector ever made!" –Forbes.com

"State of the art." –Popular Mechanics

"The World's Best!" –Radartest.com

Introducing the all new PASSPORT 8500 X50…X50 takes performance to the X-treme:

- **X-treme radar range…**up to 50% more range
- **X-treme laser response…**provides maximum protection
- **X-treme POP protection…**the most effective counter measure to the newest traffic monitoring technology
- **X-tremely quiet…**our patented AutoSensitivity™ virtually eliminates false alarms

Available with a high-intensity red or new brilliant blue display.

We're so confident that you'll love it, we'll let you drive it for 30 days-completely risk free!

The World's Best Just Got Better – Guaranteed!

Call Toll Free 1-888-8 ESCORT 1-888-837-2678

PASSPORT 8500 X50 Blue $339.95

PASSPORT 8500 X50 Red $299.95

Plus S&H. OH residents add 6.5% sales tax.

Escort Inc.
5440 West Chester Road
West Chester, Ohio 45069
Department 4068D4

ESCORT
DETECT THE DIFFERENCE
www.escortradar.com

©2004 Escort Inc

Advertisement

WIN A Tuner Car Kit!

Visit popularmechanics.com/tunersweeps to enter

See how PM revamped a Honda Civic into an awesome tuner car in the January '05 issue!

Get your car tuned up and geared up to look and perform its best. One lucky reader will win a tuner car kit.

PRIZE PACKAGE INCLUDES:

- *K&N Typhoon Intake Kit*
- *A Full Set of BFGoodrich Tires*
- *Eibach Pro-Kit*
- *Detail Bucket of Mothers Products*
- *Optima Batteries Group 51 Yellow Top Battery*
- *Accel Ignition System with Rev Control*
- *Hurst Quick/Stick*
- *G-Sport Pro Fuel Rail*
- *Lakewood Traction Bars*
- *Set of Gaskets from Mr. Gasket*
- *Knowledge Performance Flywheel*

A total estimated value of $2000!

For complete rules and details on how to enter, please visit www.popularmechanics.com/tunersweeps.

Sweepstakes Rules:
NO PURCHASE NECESSARY TO WIN. A PURCHASE OR PAYMENT OF ANY KIND WILL NOT IMPROVE YOUR CHANCE OF WINNING. From 11/01/04 - 12/31/04, participants may enter the Popular Mechanics Tuner Car Sweepstakes by filling out the online registration form at popularmechanics.com/tunersweeps. All entries must be received by midnight 12/31/04. On or about the week of 01/17/04, a random drawing will be conducted from all eligible entries to award prizes. The winners will be notified by phone or email. By entering this contest, participants agree to be bound by Official Rules. Go to popularmechanics.com/tunersweeps for complete official sweepstakes rules.

BFGoodrich · Hurst Shifters · K&N High-Flow Air Filters & Intake Kits · Lakewood Performance Group · G-Sport · Knowledge Performance Inc. · MR. GASKET Performance Group · MOTHERS Polishes•Waxes•Cleaners · OPTIMA Batteries The Ultimate Power Source · Eibach Springs The Suspension Company · ACCEL

The Goods

Great products and promotional offers from PM advertisers

From Dickies, the leader in workwear, comes the Ultimate in Work Pants.

Dickies "Ultimate Work Pant" comes with all of the features you would expect on a work pant. Made of our heavy weight 8 oz - 65% polyester/35% cotton twill, with Scotchgard® stain release finish, this pant will stand up in almost any work environment. What makes this pant unique is its cell phone pocket, double knees, hidden side-seam pocket, coin pocket and Dickies Scuffgard™ to help prevent fraying at the bottom of the leg.

What more could you want in a work pant. To find a retailer near you for this and other Dickies products, visit our website at www.dickies.com or call us at 1-800-DICKIES.

Stanley® Professional Grade Tool Set

The Stanley® Professional Grade Mechanics Tool Set consists of over 250 unique items available in six graduated sets, which are designed for the enthusiastic "shade tree" mechanic or home improvement do-it-yourselfer who likes tackling automotive, boating and home repairs on their own. Each tool is forged from high-quality steel and features a professional grade, full-polish finish for corrosion resistance and easy cleaning. Pear-head shaped ratchets feature single finger directional switching and have a quick-release socket mechanism.

STANLEY
MAKE SOMETHING GREAT™

SureFire 6P Flashlight

A favorite of law enforcement personnel, the SureFire 6P is just 5.1 inches long but packs the power of a four D-cell flashlight. Precision-machined from aerospace-grade aluminum, it delivers a 65-lumen pre-focused brilliant white beam for 60 minutes, uses two lithium batteries (10-year shelf life), and features a lock-out tailcap to prevent accidental activation. Available in black or gun metal gray. For more information, call 800-828-8809 or visit www.surefire.com.

SUREFIRE

Prestone

The NEW Prestone® Extended Life Antifreeze/Coolant is helping to eliminate antifreeze/coolant confusion for consumers. Its unique formula is compatible with ANY antifreeze/coolant – regardless of color – and can be used in ANY make or model automobile or light duty truck. The formula provides extended life properties for up to five years or 150,000 miles when flushed and filled. When added to a vehicle's current formula, it is designed to provide the properties and change over intervals of that formula. For more information, call 800-862-7737, or visit www.prestone.com

Prestone®

(Continued from page 136)

explosion blew open Lawing's toe and tore up the sole of his right foot. Shrapnel ripped through his thigh, hip and shoulder. Fragments entered his skull and brain in just about the only place they could—underneath the tip of his helmet. The Dallas native underwent immediate surgery at the Army's 31st Combat Support Hospital to remove two relatively superficial fragments in his right frontal lobe, but another fragment was buried too deeply to retrieve. A dentistry and youth ministry student at Harding University in Searcy, Ark., Lawing will require frequent brain scans to determine whether the shrapnel is moving. He can never lift anything heavy or play contact sports again.

On Sept. 17, Pannell was wheeling down the hallway to his room on the second floor at Malone House, the hotel for Walter Reed patients and their families, when he heard a familiar voice behind him. "Pannell, are you blocking the hall?" It was Doc Lawing; the two guardsmen had a warm reunion. "He looked great," says Pannell. "He looked normal."

IN MID-AUGUST, about two months after entering Walter Reed, Pannell and his family returned home to Arkansas for a 30-day convalescent leave. Although on the surface Pannell seemed to be his usual cheerful self, Amanda noticed subtle changes. Little things that never bothered him before, like navigating around Hunter's toys, annoyed him; loud noises startled him. His wife admits that the loss of his legs was a shock. "He said, 'I can deal with it,' " she says. "But he's had his days when he realized there are certain things he can't do. We're all still trying to adjust."

Pannell and his family returned to Walter Reed so Pannell could be fitted with his right prosthesis. With two legs, he began to develop a gait. He moved quickly beyond the walker to crutches and then to canes. By January he'll be ready to perform daily activities for at least 4 hours, at which time he'll be discharged from the hospital. By April, he'll be back in the community, trying to live a normal life.

Clark says all his patients at Walter Reed are highly motivated, but Pannell is special. "He thinks, 'I can do anything I want,' " Clark says. "And other patients are inspired by his belief. But we ask patients to think three things: One day at a time; time takes time; and sometimes reach back and help someone who isn't as far along as you are. Kevin has reached back and helped others, but he's not so good at understanding that time takes time."

His occupational therapist echoes that note of caution. "It concerns me," says Naranjo. "I've spoken to amputees early in their rehabilitation, and the amputations didn't affect them until two or three years later." According to Naranjo, Pannell will need to slow down and focus first on performing the little things in life: getting out the ironing board, making the bed, mowing the lawn.

But Pannell has much more ambitious plans than household chores or yardwork. First up: the New York Marathon. "This early in the game my stumps couldn't handle 26 miles," he says. "But my wheelchair can. I may get out every now and then and push it." Pannell even talks about organizing the first all-amputee team to compete in the Eco-Challenge, the 300-mile wilderness competition that includes mountain biking, river rafting and rock climbing. "We probably won't win, but half the able-bodied entrants don't finish the race," says Pannell. "Just finishing with a group of amputees would be so sweet."

Once the Army's medical board decides the amount of his disability pay, Pannell plans to retire from the military and enroll in Henderson State University, in Arkadelphia, Ark. He wants to pursue a career in occupational therapy and work with amputees. "I think I can help them," he says. "I understand what they're going through."

Meanwhile, there's always the Cleveland Browns. "They'll probably suck again this year," Pannell admits, "but the fans in the Dawg Pound are survivors—woof, woof!" PM

Families Have Saved Up To 50% On Heating Costs

And never have to buy fuel — wood, oil, gas, kerosene — ever again!

Hydro-Sil is a unique room-by-room heating system that can **save you hundreds of dollars** in home heating costs by replacing old and inefficient heating. It can replace or supplement your electric heat, gas or oil furnace and woodstoves.

Hydro-Sil represents economy in heating: inside the heater case is a sealed copper tube filled with a harmless silicone fluid. **It's permanent. You'll never run out.** "Hydro-Sil Energy Star" thermostat controls a variable watt hydro element that is *only* being supplied a *proportional* amount of power on an as-needed basis. When Hydro-Sil is turned on, the silicone liquid is quickly heated, and with its heat retention qualities, continues to heat after the Hydro element shuts off. Hydro-Sil's room-by-room "Energy Star" digital control technology greatly increases energy savings and comfort.

Your Benefits with Hydro-Sil:

- Slash heating cost with Energy Star tech.
- Lifetime warranty. No service contracts
- Safe, complete peace of mind
- Clean, no fumes, environmentally safe
- U.L. listed
- Preassembled — ready to use
- No furnaces, ducts, or chimneys
- Portable (110V) or permanent (220V)
- Whole house heating or single room

220 VOLT PERMANENT	Approx. Area to Heat	Discount Price	Quantity
8' 2000 watts	250-300 s.f.	$279	
6' 1500 watts	180-250 s.f.	$249	
5' 1250 watts	130-180 s.f.	$229	
4' 1000 watts	100-130 s.f.	$209	
3' 750 watts	75-100 s.f.	$189	
2' 500 watts	50-75 s.f.	$169	
Thermostats	Call for options & exact heater needed		

110 VOLT PORTABLES (Thermostat Included)	Discount Price	Quantity
5' Hydro-Max 750-1500 watts	$219	
4' Convector – Dual watt	$179	
3' 750 watts – Silicone	$179	
$15.00 shipping per heater	$	
Total Amount	$	

Order today or contact us for more info.

- Phone
- Web
- Mail

Check • MasterCard • Visa

1-800-627-9276

Visit our secure web site at

www.hydrosil.com

Hydro-Sil, P.O. Box, 662, Fort Mill, SC 29715

Name _____
Address _____
City _____ St _____ Zip _____
Phone _____
MasterCard or Visa Account Information:
Acct # _____
Expiration Date _____

Buyer's Guide

For advertising rates call Jackie O'Connor (212) 649-2930 or Rene Biemer (212) 649-2929. Fax: (212) 258-2253.
Send advertising material to: 810 Seventh Avenue, 6th Fl, New York, NY 10019. 1-800-333-4948.

RETROFIT WITH RADIANT

If you can see the underside of your floor, you can install comfortable, economical radiant heat.

- INSTALL IT YOURSELF
- SIMPLE DO-IT-YOURSELF RETROFIT PACKAGES
- CONNECT TO A BOILER OR A WATER HEATER

Radiantec SINCE 1975

www.radiantec.com 800.451.7593

SHOP OUTFITTERS
A Division of Lockdown Securities, Inc.

NEW 244-page Ornamental Design & Guide Book $29.00

FREE 32-page full-color catalog

www.shopoutfitters.com
(719) 676-5555 FAX (719) 676-5554

100% AMERICAN MADE

PERFECT PROJECT SPACE
25 YEAR PAINT WARRANTY
TOUGH STEEL BUILDINGS
MANY SIZES AVAILABLE
CALL TODAY FOR DETAILS
AMERICAN STEEL SPAN
800-891-6733 ext. 1236
WWW.STEELSPAN.COM
• COLORED ENDWALLS AVAILABLE •

Billiards, Darts & Poker
FREE 196-page wholesale catalog
800.627.8888
Order securely online at
www.muellers.com
Mueller Recreational Products
Dept 3, 4825 S 16th St Lincoln, NE 68512

2 SEAT BIKE
DRIVES LIKE A CAR
- Easy to Pedal
- Multi-Speed
- 1, 2 & 4 Seaters
- Optional Electric Motor

FREE BROCHURE
1-800-974-6233 Ext. 8686 • www.4wc.com/#8686
RHOADES CAR Dept. 8686 • 125 Rhoades Lane Hendersonville, Tennessee 37075

WATER PROBLEMS??

HARD WATER? IRON? BACTERIA? "ROTTEN EGG" SMELL?
Our Products Solve These Problems!
√ *No Salt* √ *No Chemicals* √ *No Magnets!*
FREE BROCHURE ~ 1-800-392-8882

GARAGE SALE

Reg. ~~$900~~
$399*
12' x 20' x 8'

Reg. ~~$780~~
$299*
12' x 20' x 8' Garage in a Box

Reg. ~~$2000~~
$999
22' x 20' x 10'

Reg. ~~$3599~~
$1699
14' x 40' x 14'
14' x 42' x 16'
ONLY $1999

1-888-995-7235
EASY ASSEMBLY
30 DAY MONEY BACK*
UP TO 15 YEAR WARRANTY*
COVERIT.com
DISTRIBUTED BY NORTH AMERICAN OUTDOOR PRODUCTS
*All prices are subject to change

ValveLock Tire Pressure Gauge

Tire Pressure Gauge

Have you had it with tire gauges that practically deflate your tires while youíre trying to get a reading?

The **ValveLock®** Tire Pressure Gauge uses a patented gripping mechanism that pulls the gauge onto the valve stem for an airtight lock. A purge button releases excess pressure!

MADE IN USA
$19.95
$2 (S&H)
Available in 15, 60, 100, and 160 psi models

Order online at ValveLock.net
or
Call 321-674-2000

HEATING & COOLING EQUIPMENT

FURNACES

STARTING AT
ONLY $675.00

- 45,000 BTUs
- 80% efficiency

- Free Shipping
- High Efficiency Models
- Natural Gas, Propane or Oil
- Large Selection

BUY WHOLESALE

- High-Efficiency Furnaces
- Heat Pumps
- Humidifiers
- Boilers
- Thermostats
- Central Air Conditioners
- Replacement Filters
- Air Cleaners
- Ductwork
- Unlimited Tech Support
- Free Shipping on Equipment Orders

Alpine Home Air Products

Buy Direct & Save
1-800-865-5931
Shop Online!
www.AlpineHomeAir.com
Or Call for FREE No-Obligation Custom Quote & Info Pack

BACKYARD "REC-ROOM"
SUNPORCH® CONVERTIBLE
SUNROOM/SCREENROOM

READY-TO-ASSEMBLE KIT
MOUNTS ON YOUR DECK OR PATIO

BUILD AND PRICE ONLINE

FULL-HEIGHT WALL SCREENS

- QWIK® window/screen change system
- Meets building codes for snow and wind loads
- No extras, comes complete
- Sold factory direct, delivered to your door

DOWNLOAD CATALOG & PRICES:
www.sunporch.com
(Web Code: POM)

OR MAIL $2 TO:
SunPorch® Structures Inc.
P.O. Box 368, Dept. POM
Westport, CT 06881-0368

SunPorch® Our 30th Year

Passin' Gas
Productions.com

$10 each plus $3 S&H ($1 ea add'l) in Res. add 7% each sales tax.

Get Your New 2005 COLLECTORS GAS PUMP WALL CALENDAR
Beautiful Images of Roadside Petroliana Taken Along the Highways of America.

Christmas Special...Buy 9 Get 1 FREE!
High Gloss • Full Color • 11x17
Starts with September '04

We accept checks, money orders or Paypal.

Passin' Gas Productions
Box 260, Dept. PM • Crescent, IA 51526
Ph: (712) 545-3652 • (712) 322-6626
Email: PassinGasProductions@earthlink.net
Web: www.PassinGasProductions.com

Simpson
STEEL BUILDING COMPANY
SERVING THE INDUSTRY SINCE 1981

- MINI STORAGE ALL SIZES
- STEEL TRUSS IN 15'-40' WIDTHS
- LARGER SIZES AVAILABLE IN RIGID FRAME
- NOT A POLEBARN
- NOT A ROUNDTOP

GET THE BUILDING YOU WANT!

STEEL TRUSS PATENT# 5377253
100% STEEL!

CALL FOR A FREE BROCHURE!
PHONE 800-847-8313
FAX 800-429-8427

WWW.SIMPSONSTEEL.COM

Humidifier & Purifier Two in one.

No need for filterpads. It's so simple.
Patent-No. 5,894,001

Dry air is difficult to clean.
Humidification plus purification is far more effective.

- The Venta-Airwasher not only washes the air, but also prevents millions of airborne particles from rising. The air is humidified, fresh and clean.
- The Venta-Airwasher humidifies and purifies the air by washing it with water. Automatically adds moisture to the air by cold evaporation, recognized as the best technique.
- Very hygienic. No odor causing bacteria-ridden filterpads. No problems with white dust.
- No filterpads to replace. Easy maintenance.

Many famous customers are already enjoying the benefits of the Venta-Airwasher: e. g. Sony Europe, Porsche, British Airways, adidas, McDonalds, Audi AG, Carnegie Hall (40 units)

BED BATH & BEYOND · ACE Hardware · True Value · LINENS 'N THINGS

100% made in Germany.
Red dot design award winner 2003.

No.1 in Germany and Europe.
Worldwide unique technology.
No need for filterpads/wicks.
No white dust. No Ions. No ozone.
10 year warranty.
Call today toll free: 1-888-333-8218

Test the Venta-Airwasher cost-free.
If there is no dealer close to you, try the Airwasher in your home for 14 days. If you are not fully satisfied, we will have the Airwasher picked up from your home via UPS and your credit card will not be charged. Free shipping anywhere in the US. Please send a free brochure to:

Name:

Address:

City: State/Zip:

Available at selected retail stores. Please call for a complete list of dealers.

Venta-Airwasher LLC. 180 Stanley Street, Elk Grove Village IL 60007, Tel. (847) 758 9598, Fax: (847) 758 9597
www.venta-airwasher.com

venta® AIRWASHER

www.polarisusa.com

Polaris Industries, Inc.

Video Security From The Professionals at Polaris

WPT-01
1/4" Color Pan/Tilt Wireless Network Camera.
MPEG-4 Compression, 10/100 or 802.11g

Affordable Pan Tilt Camera!!

WP-350C
1/3" High Resolution
Color Lipstick Camera

IR-0D
Outdoor Infrared Illuminator
12V DC, 30 Meter Distance

PDVR-40
40 GB Portable Digital Video Recorder
USB 2.0 Interface • MPEG-4 Encoding

Supports USB 2.0 & Windows XP!

DVC-1660
Digital Video Recording Solution for Your Computer!
(4 Ch. - 16 Ch.)

Happy Holidays

Local 678.405.0097 | Toll Free 800.308.4659 | Fax 678.405.6081

3158 Process Dr. Norcross, GA 30071 • www.PolarisUSA.com

NORWOOD

LumberLite 24
LumberMate 2000

From $2,695.

Personal Sawmill

1-800-661-7746 Ext 352
www.norwoodindustries.com

AMAZING DEVICES
www.amazing1.com

GREEN LASER POINTERS — Ultra Bright

5 mw green visible beam. Range over 3 miles!!!
LAPNGR5C with range extending lenses.....$129.95

ANTI GRAVITY PROJECT
Float objects as seen in video on web site. Many crafts shown
GRAAP Power source and CD-ROM.....$149.95
Free catalog on web or send $2.00 to INFO UNLIMITED
PO 716 Amherst N.H. 03031 E mail <info1@xtdl.com>
Orders 800 221 1705 /info 603 673 4730/ Fax 603 672 5406

FUTURE STEEL BUILDINGS
FACTORY-DIRECT WHOLESALE PRICES!!
1-800-668-5111 ext.1530

Discount Smokes!

MARLBORO - All Styles
$26.99 carton

NATIVE - All Styles
$11.99 carton
Comparable to America's red box Premium

SENECA - All Styles
$9.99 carton
Unparalleled taste that comes from a 100% blend of the world's finest Carolina tobaccos.

We carry all brands!

$5.00 Off Your First Order!
USE CODE PMN-1184
3 carton minimum order. Expires 11-30-04

ORDER TOLL FREE: 1.800.272.1743
FREE FAX: 1.877.272.1749

SURGEON GENERAL'S WARNING: CIGARETTE SMOKE CONTAINS CARBON MONOXIDE. Must be 21 years old to order. Buyer responsible for payment of all applicable sales taxes.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

S7-PMN-1184-48-X

SmokeSignals Advantage...

- Most orders ship in 24 hours or less
- 45-day No Hassle Return Policy
- VIP Club – each purchase earns you free gear!
- Auto-Ship the absolute in convenience & saves you money!
- Monthly contests – 5 lucky people – each get $100.00!
- Sample Program – lets you try before you buy

SMOKE SIGNALS .com

HERITAGE
BUILDING SYSTEMS®
Established 1979

800-643-5555

WE SHIP ANYWHERE IN THE USA!

30' x 40' x 10' $6,588
40' x 60' x 14' $11,404
50' x 75' x 10' $15,948
60' x 100' x 18' $31,500

For 25 years, Heritage has been the low price leader. Any size is available featuring easy bolt up rigid frame design for industry, office, mini-storage, shop, farm and All Steel Homes. Call us today for a free information package and quote on the best buildings made. Codes and options may affect prices.

ALL STEEL HOMES

Southridge I $29,755

Mini-Storage Sale
$6,628
10' x 100' with 10 units complete with partitions
www.heritagebuildings.com

FREE SAMPLE*
CALL 800-521-2663
TWO PART EPOXY GEL IN A SINGLE USE PACK

- FIRST OF ITS KIND
- CONVENIENT
- EASY TO USE
- NO MIXING CUP
- NO MIXING STICK
- NO MESS!

ND INDUSTRIES

Call for details. Shipping & handling costs extra.

® REACT-A-PACK, NO Industries are registered trademarks of NO Industries, Inc.

IronProjects.com
for the beginner...
- ✓ Iron Projects Video
- ✓ Welding Manuals

for the professional...
- ✓ Drawing Software
- ✓ Iron Design Books

for CNC machine owners...
- ✓ CNC Art Disks

RedPup Productions
928-775-0505

Dr. Winnifred Cutler
Creator of 10X

RAISE the OCTANE of your AFTERSHAVE

ATHENA PHEROMONE 10X

unscented cologne/ aftershave additive

10X™ INCREASES YOUR SEX APPEAL

Joseph (MI) **"Fabulous product. I was shocked when I first got it and tried it. I had read on the internet, everything on your web site. You know, you hear all kinds of things about pheromones and don't know what to believe. But you guys were very well respected, you have gone through the studies. you did the double blind studies. You did the research!** A long time ago, I learned, you get what you pay for. **Well even so, I was shocked at how well 10X works. You have a fabulous product.** I am married and am with my wife only. **Well within 5 days it was amazing. The affection level went up 20 fold.** I am so grateful to you Dr. Cutler. Thank you so much for your research!"

Actual Testimonial Received 6/26/04

GET MORE AFFECTION from WOMEN

Created by Winnifred Cutler, Ph.D. in biology from U. of Penn, post-doc at Stanford. Co-discovered human pheromones in 1986 (Time 12/1/86; and Newsweek 1/12/87).

athenainstitute.com

Vial of 1/6 oz. added to 2-3 oz. of your fragrance **lasts 4 to 6 months.** Contain human synthesized pheromones. Not guaranteed to work for all; body chemistries differ; **will work for most.** Cosmetic products; not aphrodisiacs. Patents Pending. Not in stores.

Call (610) 827-2200 – Order online - or send to:
Athena Institute, Dept PMxd,
1211 Braefield Rd. Chester Springs, PA 19425

Please send me ____ vials of 10X for men @$99.50 and/or ____ vials of 10:13 for women @$86.50 for a *total ____ by: ❑ money order ❑ check
❑ Visa,M/C,Disc.____-____-____-____
exp_____signature_____
to: Name_____
Address_____
City/State_____zip_____
Phone:_____email_____
(*PA add 6% tax, Canada add US $7.50 per vial) PMxd

FREE Shipping

For Increased Button Profits with
Badge-A-Minit®

Expand your profitability with Badge-A-Minit buttons. Using our **Starter Kit** you can create customized buttons for customers. Buttons cost less than 16¢ to make and can be sold for $1 or more. Your Starter Kit is only $39.95 and contains everything you need to get started.

Request your **FREE** catalog or order today!

www.badgeaminit.com

Badge-A-Minit, Dept. PM1204, 345 N. Lewis Ave., Oglesby, IL 61348
Call 800 • 223 • 4103

OWN A MACHINE SHOP

Smithy.
- **Easy to use** – No experience required.
- **Versatile** – Fix or make almost anything.
- **Affordable**– 6 models starting at $995.
- **CNC Compatible**

Do It Yourself on a Smithy Lathe•Mill•Drill!
"I can fix most anything. I don't know how I lived without my Smithy. It paid for itself in no time."
GUARANTEED TO MAKE MONEY OR IT'S FREE!!
1-800-476-4849
Or Write Smithy-Dept PM P.O Box 1517, Ann Arbor, MI 48103
www.smithy.com

FREE! Info Kit Call Today!

CAD DIGGER

Build It Yourself
Backhoe • Scrad
For Free Brochure

Plans for several models. - 5 to 9 ft digging depth - free standing or 3pt hitch Starting at $1000 to build No machining Car Towable

Visit our website- www.CADplans.com

P.O. Box 606, Dept. P • Daleville, VA 24083 • 1-800-817-5267

SINGERS! REMOVE VOCALS

Unlimited Free Backgrounds from *Original Standard* Recordings!
Thompson Vocal Eliminator™ VE-4 Free Brochure/Demo
24 Hour Demo/Info Line (770)662-9925-Ext 61
LT Sound Dept PM-1 7980 LT Parkway,Lithonia, GA 30038
www.VocalEliminator.com/g.o/PM
Better Than Karaoke For Over 25 Years!

A steel Garage/Workshop that is as attractive as it is durable.

It's gotta be a Miracle.™

MIRACLE TRUSS Pre-engineered Building Systems

Unique steel web-frame design · Fast & easy do-it-yourself assembly · Customizable to meet your needs

FACTORY-DIRECT PRICES	ONLY
30' x 36' ($12,376 value)	$8,043

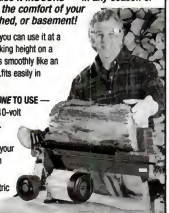
Other building sizes available at great prices too!

MIRACLE TRUSS® CALL TODAY **1-866-250-3467**
www.miracletruss.com PM

• New • Convenient • Easy-to-Use

ELECTRIC-POWERED WOOD SPLITTER!

The DR® WOOD SPLITTER is so QUIET and CLEAN — you can even use it INDOORS — in any season or weather — in the comfort of your own garage, shed, or basement!



- **SO COMPACT** you can use it at a comfortable working height on a workbench...rolls smoothly like an airline suitcase...fits easily in your car's trunk!
- **EASY FOR *ANYONE* TO USE** — plugs into any 110-volt household outlet. Push-button operation keeps your hands away from moving parts!
- **POWERFUL** electric motor drives a hydraulic ram, producing 4 TONS of splitting force!

TOLL-FREE
1-888-294-5026
www.drwoodsplitter.com

Please send full details of the Amazing Indoor/Outdoor **Electric DR® WOOD SPLITTER**, including your Free Trial Offer, low, factory-direct prices, and seasonal savings now in effect.

Name_____

Address_____ Apt/

City_____ State____ Zip_____

E-mail_____

COUNTRY HOME PRODUCTS®, Dept. 49395X
Meigs Road, P.O. Box 25, Vergennes, VT 05491

© 2004 CHP, INC.

instantgarages4less.com

INSTANT GARAGES • PARTY TENTS • GREENHOUSES

1-800-447-7079

7 DAYS A WEEK • DEALER INQUIRIES WELCOME

SECRETS!

- **Melt Metal!** Incredible plans, lost secrets, forgotten how-to, and
- **Machine Shop!** strange books! Request a catalog! Melt metal! Be a
- **Hydrogen!** machinist, blacksmith, mad sci-
- **Homesteading!** entist! Make neon signs, rewind motors. Get high
- **Engines!** power from auto alternators, gen-
- **Old Time Radio!** erators, windmills. Build a working solar
- **Tesla!** cell, crystal set, hydroponics, Tesla coil, more! Make booze, soda pop, chemicals,
- **Chemistry!** embalm corpses! Homestead! Mold plastic! Work sheet metal!
- **Science!** Steam engines, science experiments! Secret formulas, recipes, how-to! All
- **Steam!** books highest quality! Guaranteed!
- **Much More!** Fast service! BIG CATALOG! REQUEST ONE TODAY!

www.lindsaybks.com

Lindsay's **Technical Books!**
Box 538, Bradley IL 60915

BUILD & FLY YOUR OWN HELICOPTER

Check out...
- New 4-Stage Purchase Program • Comprehensive Construction Maintenance Videos • Manuals • Flight Maintenance Training • Insurance and Financing Available • Excellent Safety Record with Proven Performance and Reliability
- Patented Electronic Fuel Injection/Ignition

ROTORWAY INTERNATIONAL
Phone: 480-961-1001 • fax: 480-961-1514
Website: www.rotorway.com • e-mail: rotorway@rotorway.com
4140 N. Mercury Way • Chandler, AZ 85226

Order your Info Pack and Video Today!
Video $15,
Info Pack $15,
Both $25
(Add $5 for non-US)

SUPER|CIRCUITS www.supercircuits.com

VIDEO CRIME STOPPERS AND JAW DROPPERS!!!

Supercircuits delivers everything you need to catch lowlife criminals red handed, including wireless video, covert video, internet video, and more. From the most economical $12 micro camera to advanced 16 camera systems, Supercircuits delivers cost effective crime stopping performance and rock solid reliability.

WORLD'S BEST VALUE COVERT PINHOLE VIDEO CAMERA

$11.95

Put it on your R/C plane with our video smitter for a bird's eye view!

4 CAMERA QUAD DOME VIDEO SECURITY SYSTEM

Complete system, great for stores!

$279.95

SEND VIDEO & AUDIO UP TO 300 FEET!

This 2.4GHz audio/video link works with any video camera. Operation is easy and license free.

$49.95

MICRO WIRELESS CAMERA TRANSMITS UP TO 150 FEET!

$89.95

Tiny 1.45" color video camera comes w/ pinhole lens transmitter reciver & power supplies

WORLD'S SMALLEST VIDEO CAMERA

Featured in the Guinness Book of Records!

$89.95

COMPLETE AUTOMOTIVE VIDEO SYSTEM

Back up your vehicle safely and easily

$99.95

MICRO DIGITAL VIDEO RECORDER

$499.95

Pocket size, records up to 40 hours!

1280 HOUR TIME LAPSE VCR

$159.95

110% LOW PRICE GUARANTEE

*Some restrictions apply. See catalog or website for details

QUALITY SERVICE INNOVATION 15 Years

1-800-335-9777

1 Supercircuits Plaza Liberty Hill, TX 78642

Stow gear & deer. Stay clean & dry.

- 6-wheel drive
- Amphibious!

max all-terrain vehicles

1-800-255-2511
www.maxatvs.com

BUILT TO LAST AND PRICED TO SELL...

Compare our everyday price for our 25'x40' building:

$4,990 FRONT END OPTIONAL

- **EASY DO IT YOURSELF**
- **30-YEAR WARRANTY**
- **100% USEABLE SPACE**

• Many sizes, shapes & applications! • Tough, rugged building – lasts! • Heavy gauge Galvalume steel • Easy to finish trussless interior • Totally maintenance free!

PIONEER STEEL BUILDINGS GO FACTORY DIRECT
800-668-5422
www.pioneersteel.com 25 YEARS OF REPUTATION BUILT OF STEEL

Classified Ads

To reach over 9 million prospects, or for additional advertising information, call McNeill Group, Inc toll free at: 1-800-394-5157, ext. 48 fax: 1-215-321-9636, or e-mail: jmejzak@mcneill-group.com. Thank you for choosing Popular Mechanics Classified Advertising. 385 Oxford Valley Road, Suite 420, Yardley, PA 19067. For subscription inquiries call 1-800-333-4948.

12 VOLT COMPUTERS

XENARC 7" LCD TOUCHSCREEN VGA MONITORS and in-car computers. 888-475-3407 Visit KarPC.com

ALTERNATIVE ENERGY

COLD SHOP OR BARN? Heat it with Infrared! Reduce your heating costs with increased comfort www.irheating.com 888-852-3611

SOLAR & WIND ELECTRICITY ENERGY SAVING APPLIANCES, Telescopes, Propane Refrigerators, Water Pumps, Composting Toilets, Solar Cookers, Bed Warmers, Grain Mills & **MUCH MORE!!! $4 Catalog. 785-364-4407 www.KansasWindPower.net**

GREAT CHRISTMAS GIFT! Dimension EDGE American Bicycle Engine. Powerful, 35 MPH, yet quiet. DOT legal. 406-652-6766 www.monsterbicycle.com

BUILD UNDERGROUND: HOUSES/SHELTERS/GREENHOUSES **DIRT CHEAP!** Seen on HGTV, "Impressive"—NPR 800-328-8790 **www.undergroundhousing.com**

APPAREL

SUSPENDERS WITH PATENTED NO-SLIP CLIP. Free Catalog 800-700-4515. **www.suspenders.com**

ARTS, CRAFTS, SUPPLIES

WHOLESALE PRICES ON CLOCK WORKS, jewelry craft supplies, beading supplies, rock-hound supplies, cut stones. Catalog $3.00. $4.50 refundable with first order. Eloxite, Dept. 45, Box 729, Wheatland, Wyoming 82201

AUTOMOTIVE

ATTENTION TUNERS Extend Engine Life with pre and post lubrication www.motorsaver.us

CV AXLES. New & re-manufactured constant velocity axles. Auto, atv, racing, industrial. Constant Velocity Of Ocola. www.cvaxles.com 1-800-889-2953.

NEVER BUY ANOTHER BATTERY! Extend battery life, revive dead batteries. www.batterylifesaver.com 727-446-8400

$500! POLICE IMPOUNDS! Cars from $500! For listings 800-747-9319 ext V503.

AUTO SUPPLIES AND EQUIPMENT

AMSOIL SYNTHETIC LUBRICANTS. Buy Direct. Register to Buy Wholesale. **FREE CATALOG.** 1-888-826-1166. www.synthoils.com

WE ABSOLUTELY GUARANTEE AT LEAST 25% INCREASE in your fuel economy & up to 30% more hp & drastically reduces emissions. Virtually all gasoline engines. **Does it sound too good to be true? That's why we offer a 30-day money back guarantee. 214-350-2616. www.aquatune.com**

AVIATION

RADIO CONTROLLED FLYING MACHINES Electric Airplanes, Blimps and helicopters. $2.00 for Catalog: DraganFly Innovations, 2108 St. George Ave., Saskatoon, SK S7M0K7 Canada. www.rctoys.com 1-800-979-9794

AVIATION ART

AVIATION PRINTS. All eras of aviation from the Wright Brothers to the hottest modern jets. Also calendars and books. Perfect gifts for aviation lovers! www.planepix.com 775-219-6270

BANJOS

DEERING BANJO COMPANY OFFERS QUALITY BANJOS from $399. American Made. Free Catalog 800-845-7791 Extension: PMC

BICYCLES

GOLDEN EAGLE BICYCLE ENGINES Dependable Commuter Transportation Up to 250mpg & 30 mph w/200 +lb rider. 517-410-2793 bikeengines.com

BOATS, OUTBOARDS, TRAILERS AND KITS

BOAT KITS - PLANS - PATTERNS - SUPPLIES Catalog $5.00, Clarkcraft, 16-6 Aqualane, Tonawanda, NY 14150. 716-873-2640. www.clarkcraft.com

BOAT PLANS- WWW.GLEN-L.COM, $9.95 for 216-page Design Book. Over 240 designs, **Glen-L,** Box 1804/PM44, 9152 Rosecrans, Bellflower, CA 90707-1804, 562-630-6258

BUSINESS OPPORTUNITIES

$62,000.00 MONTHLY MADE IN SOFTWARE BUSINESS! Software Dealers Needed! No Software Experience Needed. No Computer Needed! Free Information Kit! 1-888-558-9647 Ad # 1602

LEARN to Earn $5-7,000++ a week from home in your own biz. Not MLM. 24-Hr/Msg 800-276-5812

ACQUIRE REAL ESTATE! You find, We Fund. Co-own or Cash Out! 1-866-541-1792 x 300

EPOXY YOUR GARAGE OR WORKSHOP floor with the original 100% solids coating system from **MUSCLEGLOSS** Do-IT-Yourself starting at .75 sq/ft. **866-456-7766**

BECOME A HOME INSPECTOR for just $49! Free information. **www.HomeInspectionBook.com** or call 540-372-9432. 24hrs

MAKE YOUR DREAM COME TRUE, earn $75,000 yearly repairing, not replacing, cracks in windshields. Call 800-826-8523 (US/Canada) Glass Mechanix, 4881 W. Hacienda Ave. , Las Vegas, NV 89118. **Website: www.glassmechanix.com**

HOTTEST & Most Profitable Opportunity. Free info: Zaken, Dept: C28063, 20700 Plummer St. Chatsworth, CA 91311

RECORD VIDEOTAPES, BURN DVD'S! Easy $1,800.00 Weekly Home Income! Free Startup Information Kit! (205)-663-9888. **WWW.CMSVIDEO.NET,** Department 158, 210 Lorna Square - #163, Birmingham, AL 35216-5439

MAKING MONEY WITH SCRAP METAL
$11, 21913 Lakeland,
Saint Clair Shores, MI 48081

FREE eBook on Three Different INCOME STREAMS. Quit Your Job! For Any Age. No Experience Needed. UNLIMITED INCOME POTENTIAL! www.TopESource.com

CUTLERY

KNIVES, KITCHEN CUTLERY and MULTITOOLS at amazing discount prices! Huge selection, prompt service. **FREE** shipping offer. **FREE** knife information. **www.UsefulKnives.com**

DO-IT-YOURSELF

PLANS for the "do-it-yourselfer!" Woodworking and metalworking. 724-929-4406 **www.how-to-plans.com**

HYDRAULIC JACK REPAIR
Manual and catalog: $10.00.
620-594-2247. Hydraulic Parts Supply,
PO BOX 97-PM, Sawyer, KS 67134

FACTORY STEEL BUILDINGS.COM manufacturer of top quality pre-engineered steel buildings. 1-800-454-3333

DVD'S AND ACCESSORIES

ELIMINATE DVD COPYGUARDS COPY YOUR DVD'S IMPROVE PICTURE QUALITY **WWW.IHEATS.COM**

DVD COPYGUARD ELIMINATOR, R.C. Distributing Co., P.O. Box 552, South Bend, IN 46624, 574-233-3053. www.rcdistributing.com

EDUCATION & INSTRUCTION

SOON THE MARK OF THE BEAST WILL BE ENFORCED. Those that receive it, will receive the wrath of God. Find out who the BEAST is, and how to avoid his MARK. No obligation. No one will call. Write for free book to: THE BIBLE SAYS P.O. Box 771 Athens, TN 37371. Phone toll free 1-888-211-1715

ENGINES, MOTORS & STARTERS

ENGINES – Briggs, Kohler, Others – HUGE DISCOUNTS! Catalog $3.00. Engine Mart, 2642 Newfound, Merritt Island, FL 32952

FINANCIAL

FREE GRANTS- Home Purchase/ Repair/ Business Education. $5000-$500,000 800-306-0873/888-384-9608 www.capitalpublications.com **800-416-0712**

$5,000 CREDIT GUARANTEED!
Unsecured Visa, MC. Bad credit approved. 1-800-242-0363 ext. 3546

$$ IMMEDIATE CASH LOANS-GRANTS $$
$1,000.00—$300,000.00 AVAILABLE. REGARDLESS OF CREDIT/ INCOME!! SAME DAY PROCESSING! CALL ANYTIME: **1-800-691-0210**

FOR INVENTORS

ΦΔΣχ - PATENTS MAY BE GREEK TO YOU - to me they are "plain English." AFFORDABLE Patent, Trademark & Copyright Applications by Registered Patent Agent with 25 years experience. Free Info 1-888-404-1999 www.patentservices.com

PROTECT YOUR OWN INVENTION Write Your Own Patent Application PatentPro® Software www.patentpro.us

GIFT IDEAS

GIVE HER a gift you'll really enjoy. Make LoveArt this Christmas www.liberator.com

GUNSMITHING

NEW! HOW-TO GUN REPAIR & Customizing Videos. 1-800-797-0867. **www.americangunsmith.com**

HEARING AIDS

HEARING AID REPAIR All makes/models, nationwide, since 1967. 800-653-8882. www.LilliElectronics.com

HEARING AIDS - GUARANTEED LOWEST PRICES! No huge commissions. Home trial, terms. All makes. We're the oldest, biggest, best. Custom instrument specialists. Free information, 1-800-323-4212. Lloyds-PMC

DIGITAL CUSTOM HEARING AIDS - FREE CATALOG, Powerful Custom Aids, B.T.E.'s, Top Brands, All Styles. Repair Service and Accessories. SAVE 1/2 OR MORE. Power Hearing, P.O. Box 64326, Virginia Beach, VA 23467-4326. 1-800-260-4134, **www.powerhearing.com**

FREE HEARING AID CATALOG!
Huge Discounts! Lowest Prices!
Save 70%! Trial! 1-800-462-5778

FREE HEARING AID CATALOG. CUSTOM DIGITAL AND PROGRAMMABLE. HUGE SAVINGS. 45 DAY TRIAL. BETTER HEARING, PO BOX 219 DEPT 32, BROOKPORT, IL 62910. 1-800-320-3300

HELP WANTED

$400 WEEKLY ASSEMBLING Electronic Circuit Boards/Products. Rush S.A.S.E.: Home Assembly - PM, P.O. Box 216, New Britain, CT 06050-0216

$900-$2,320 WEEKLY POSSIBLE!
Mailing brochures from home. FREE INFO. 1-800-890-4175 24 hrs.

HOME IMPROVEMENT

INTERIOR STORM WINDOW KITS. Plexiglas. Magnetic. Economical. Soundproof. Invisible. Guaranteed! 800-321-WARM. www.windowsaver.com

LEAKING SHOWER DRAIN?
"Replace the drain, not the whole shower" **WingTite Drain** installs from the top, no below access required. **www.wingtite.com 800-200-2678**

HOVERCRAFT

SIDE X SIDE 4 SEAT Reversible. Assembled or kit. 800-285-3761. www.neoterichovercraft.com

INVENTORS

HAVE AN IDEA? We can help submit to industry. Patent Services. 1-888-439-IDEA

Litman Law
Richard J. Apley
Former USPTO Director, Independent Inventor Programs
Searches/Applications/Trademarks

Near USPTO	Free Information
www.4patent.com	1-800-4-PATENT

ACCUSEARCH Specializes in Thorough, Prompt, Inexpensive Patent Searches. 1-800-999-5498

PRODUCT DESIGN and PROTOTYPING Let us help you bring your ideas to life! www.ProductDevelopmentInc.com 1-727-490-2269

STRAIGHT ANSWERS to your patent and invention questions from Registered Patent Attorney, Tim Barlow 703-864-7965, www.barlowpatent.com

S.E.L.L. ® YOUR IDEA Free info on Patents, Licensing, Marketing, Professional Prototypes. 800-451-1326 www.harshawresearch.com

INVENTORS: Free information tells how to offer your invention for sale or license. Kessler Corporation, 49 years 800-537-1133, ext. 25, www.kesslercorp.com

NEW INVENTIONS & IDEAS NEEDED
Davison is looking for new or improved product ideas to prepare and present to corporations. We can help make your idea a reality! Free Information Package. Call 1-800-554-3327

DEAL DIRECTLY WITH REGISTERED PATENT AGENT and qualified US Patent Office Examiner **DON'T BE FOOLED BY PHONIES,** Free patent information – "Patent, Develop, Market Your Invention". Richard L. Miller, 12 Parkside Drive, Suite M, Dix Hills, NY 11746-4879. 631-499-4343, 1-800-242-9853, HTTP://WWW.pto-ag.com

INVENTORS – NEVER SEND IDEAS TO STRANGERS! LEARN AFFORDABLE PROTECTION / MARKETING METHOD NON-PROFIT ORGANIZATION. FREE INFORMATION: 1-800-846-3228. www.inventassist.com

LADDERS

LITTLE GIANT LADDERS As seen on TV Free Catalog Call 1-800-833-0800 www.Industrialladder.com

LIVE STEAM MODELS

WORKING STEAM MODELS! Christmas Discounts! Accessories, Parts, Stirling Engines, Limited Edition Tin Toys. Catalog $6.95 Refundable. **www.yesteryeartoys.com 1-800-481-1353**

MACHINERY, TOOLS AND SUPPLIES

NEED METAL? SMALL ORDERS WELCOME. ALUMINUM, BRASS, STAINLESS, ETC. WWW.INDUSTRIALMETALSALES.COM, 1-586-783-2238

4" METAL Cutting Lathe $153.20 www.taigtools.com 12419 Nightingale, Chandler AZ. 85249

MATTRESSES

UNIVERSITY PROVEN BETTER SLEEP, Patented Memory Foam/Lever Spring mattresses. Plus: Airbeds, Water-beds, Pillows. Dealers Nationwide: 1-800-457-6442 www.SUPPLE-PEDIC.com

MODELS

STEAM AND STIRLING ENGINES, machine shop tools, boilers, accessories. Catalog $3.00. PM Research. Inc. Dept 7T, 4110 Niles Hill Road, Wellsville, NY 14895 or **www.pmresearch.com**

MUSIC INSTRUCTION/INSTRUMENTS

JUST STRINGS for Guitar, Bass, Orchestral, Folk and Ethnic instruments. World's largest selection. Rated "Top Service- 5 Stars" by Yahoo! www.juststrings.com

ACCORDIONS, CONCERTINAS, Button Boxes, New, Used, Buy, Sell, Trade, Repair. Castiglione, Box 405, Warren, MI, 48090. Catalogs $5. (586)755-6050 www.Castiglioneaccordions.com

OF INTEREST TO MEN

MEET 1,000 LATIN WOMEN! South American Singles Vacations. FREE Brochures! (713) 896-9993. www.tlcworldwide.com

ASIAN Brides! Worldwide! Free Details/ Photos! PIC, Box 4601-PM, T.O., CA 91362. 805-492-8040. www.paclsl.com

BEAUTIFUL RUSSIAN and Ukrainian ladies seeking husbands. On-line at www.svetlanas.com

IS IT BETTER THAN VIAGRA? Buy two bottles, get one free. Call Mother Natures. 1-800-458-1613

YOU DON'T HAVE TO FEEL THAT WAY. Send $3.00 for life management tips. P.O. Box 824, West Caldwell, NJ 07007-0824

OPTICS

A. JAEGERS JR, OPTICS INC. www.ajaegers.com Lenses, prisms, telescope parts Free catalog on the Web or send $3.00 to 43 N. Prospect Ave., Lynbrook, NY 11563 516-872-8111 Fax 516-872-8112

PLASTICS

PLASTICS-PURCHASE ON-LINE Visit www.modernplastics.com. Hundreds of plastic sheet, rod, tube, film and accessories on-line. Credit Cards, Fast Ship

REAL ESTATE

FREE! OZARKS' LARGEST REAL ESTATE catalog! Affordable mountain properties of all types. **1-800-591-4047,** e-mail: **omi@jamisonsvcs.com**

GOVERNMENT LAND US CITIZENS ONLY. 20-160 acre claim program still available, get yours for $20.00 government fee, IN AK, AZ AR, CA, CO, ID, MT NV, NM, OR, UT, WA, WY. For complete, step-by-step package including maps, telephone help line, filing forms, etc. send $20; or for more information send $3. PUBLIC LANDS TITLE, PO BOX 2945-PM Port Angeles, WA 98362-0336(this is not Homesteading, it's much easier and only costs $1 per acre) www.governmentland.com

HOMES FROM $10,000! 4% Down, 30 years @ 8.5% APR for listings 800-747-9364 ext B533

REAL ESTATE WANTED

WE BUY HOUSES, Apartment Buildings, etc. Can Pay Cash or make Payments. 877-642-2897

SECURITY SYSTEMS

WIRELESS HIDDEN CAMERAS In briefcases, books, sunglasses, clocks, and more. Stun guns, pepper sprays, self defense products. Distributors wanted. We drop ship. 800-477-1739. www.safetytechnology.com/pmc

FREE WHOLESALE CATALOG. Tasers, Myotrons, Pepper Sprays. Great Business Opportunity. www.lalawenforcers.com Toll free 1-877-243-9482

SPECIAL SERVICES

INFORMATION On anything. Ferguson Research Specialist, 60-15 Woodside, Woodside, NY 11377

STAIRS

SPIRAL STAIR KITS. Patented all-wood design. Precision Pine Inc. 877-885-8902. www.spiralstaircase.com

STAMPS

PENNY STAMP APPROVALS, regardless catalog. Carl Kloster, 18282 Lawson Valley Rd., Jamul, CA 91935

SURVEILLANCE

NANNY CAMS, HIDDEN VIDEO SYSTEMS phone recorders, and much more. 1-877-SPY-CONN www.spycountry.com

TOOLS

BOLTS, SCREWS, TOOLS, WHOLESALE, DIRECT. Guaranteed. Catalog $2.00. (Refundable). Camelot, Dept. 44, Box 65, Bristol , Wisconsin 53104

TREASURE FINDERS

BURIED TREASURE – Sensitive equipment allows locating from distance. Brochure free. Simmons, Box 10057-MA, Wilmington, NC 28404

TRUCK SHOP TOOLS

TRUCK SHOP TOOLS AND EQUIPMENT. New and reconditioned. One-year guarantee. **"The Best for Less"** Visit **www.wesbrooksinc.com**

WANTED TO BUY

BUYING GOLD, SILVER, PLATINUM-ANY FORM; 60 years experience Free pricing quotes. Top payment. 1-800-932-1010 www.preciousmetalsreclaiming.com

WATER PURIFICATION

100% STEAM DISTILLED... Countertop water purifiers. Free information packet. 1-800-874-9028. www.waterwise.com

WORKING STIRLING ENGINES

STIRLING ENGINES, Steam, Limited Edition Tin Toys, Boats, Trains & Accessories. Christmas Discounts! Catalog $6.95 Refundable. **www.yesteryeartoys.com 1-800-481-1353**

WINEMAKING/BEERMAKING

WINEMAKERS - BEERMAKERS. Free Catalog. (800)841-7404. Kraus, 7850-L, Independence, Missouri 64054. www.eckraus.com/offers/l.asp

Harbor Master

[BRENT MCLAIN, COMMERCIAL DIVER, YEARS ON JOB: 5]

A DAY'S WORK for Port of San Francisco diver Brent McLain might entail struggling against a 5-knot current while dragging 200 ft. of hose, using power tools in total blackness, and fending off curious 700-pound harbor seals. Along with two other divers, McLain helps maintain tens of thousands of pier piles, salvages wrecks and assists officers with homeland security. His gear takes a thrashing. "Water is a mystery," McLain says. "Put something in it, and it breaks." McLain relies on land-based air and power supplies, and a team of two (a backup diver and a tender) to monitor his every breath.

Photograph by ERIC BUTLER

A BAD DAY AT WORK?
"You can get fouled in a net, tangle your hose on a pile, have a mudhole cave in on you," says McLain. Worst case? Cutting the hoses. Then, "it's a one-man show. No air. No communication. I have 3 to 5 minutes of oxygen in my suit." Just enough time to weigh the options.

DRY SUIT
The watertight Mobby's Discovery Dry Suit protects McLain during his 4-hour stretches in the 50-odd-degree water of San Francisco Bay. Chafing pants guard against jagged debris.

WEIGHT SYSTEM
McLain wears up to 50 pounds of lead on a Miller weight belt. (A spring-loaded buckle facilitates one-handed escapes.) He also inserts steel plates in his boots and straps on 5-pound ankle weights. The result? Around 95 pounds of gear—and a man who's much happier underwater.

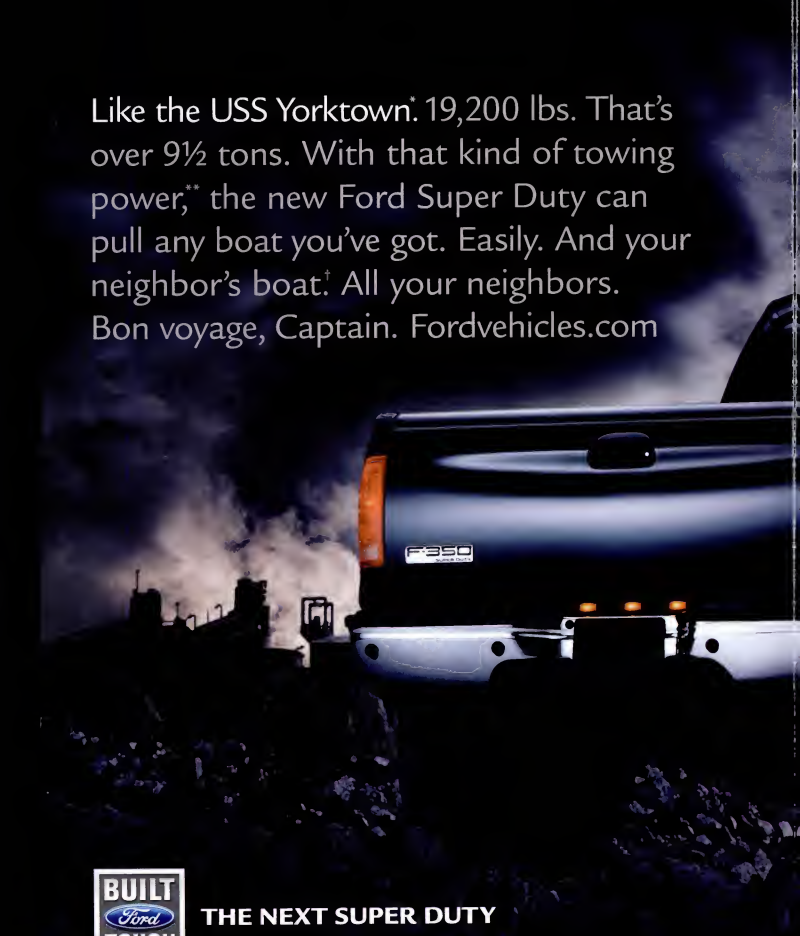
FIBERGLASS HELMET
The Kirby Morgan SuperLite 27 helmet is rigged with a microphone and speakers, flashlight and chrome-plated brass closures. At 37 pounds the SuperLite weighs about half as much as old-style metal helmets.

HYDRAULIC CHAIN SAW
The Stanley CS06 Underwater Chain Saw helps McLain level rotten piles; the Stanley drill at his feet bores holes for the pins that anchor new piles to the remaining stubs. Wielding power tools in silty "black water" is the diver's riskiest task. "Most of our work is by feel," says McLain.

TORCH
McLain cuts steel with the Arco BP-32 Torch, which shoots oxygen through a magnesium rod that hits 10,000 °F. The unit uses an electrical charge—which travels through the water, "It'll wake you up," McLain says.

RACK BOX
The Ammap Amcommand II unit contains a depth gauge, an air-pressure control that sounds an alarm when a diver's air drops to 700 psi, and a two-way radio. The 400-ft. media cable that connects to the helmet is military surplus.

Like the USS Yorktown*. 19,200 lbs. That's over 9½ tons. With that kind of towing power,** the new Ford Super Duty can pull any boat you've got. Easily. And your neighbor's boat.† All your neighbors. Bon voyage, Captain. Fordvehicles.com



BUILT Ford TOUGH

THE NEXT SUPER DUTY

*USS Yorktown weighs 41,000 tons. **19,200 lbs. towing, late availability. Fifth-wheel towing. Optional on F-350 DRW 4x2 Regular Cab: 4.30 limited slip rear axle with Power Stroke® 6.0L Diesel engine, TorqShift™ automatic transmission and TowCommand System. Shown: F-350 Lariat DRW SuperCab, 14,799 lbs. maximum towing. †Vehicle can only tow one boat at a time.

Copyright Advertising

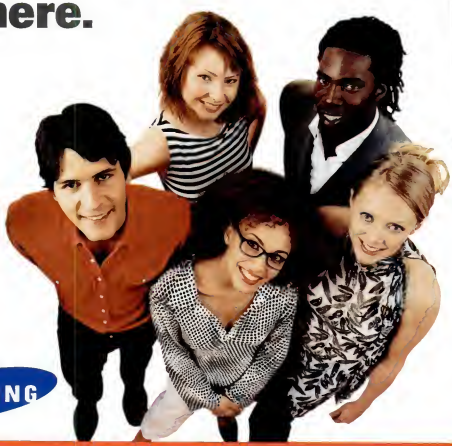
4x4
Ford

WE'RE GONNA NEED A BIGGER BOAT.

Sprint®

TV: Appearing in better pockets everywhere.

Sprint PCS Vision™ Multimedia Phone MM-A700 by Samsung®



The excitement of TV, right in your phone.

It's a true multimedia experience from Sprint PCS Vision™ and Samsung.® Watch high-quality streaming video from Sprint TV, featuring clips from CNN,® FOX Sports,® The Weather Channel® and more. All on a Sprint-powered Media Player, with exceptional sound and in vivid color. Amazingly, that's not all:

- It has a 1-megapixel flash camera with swivel design.
- You can shoot 15-second video clips with sound.
- It's Sprint PCS Vision capable, for games, ringers, screen savers, Web and more.
- And it's SMS Text Messaging capable, of course.

Sprint PCS. Now, that's better.™

Sprint Store™

To order your phone with free delivery:
www.sprintpcs.com
1-800-480-4PCS

The Sprint Store At RadioShack.

BEST BUY

Nationwide network reaches over 240 million people. Phones may not be available everywhere. Premium Services, including SMS Text Messaging and Sprint PCS Vision services and applications are optional and available for an additional charge with a Sprint PCS Service Plan. **Sprint PCS Better Wireless Guarantee:** Return policy includes phone refund within 14 days of activation (usage charges still apply). Phone upgrade available after 18 months' continuous service on plans $34.99 per month or higher while in good standing. Requires a one- or two-year agreement at upgrade. ©2004 Sprint. All rights reserved. Sprint and the diamond logo are trademarks of Sprint Communications Company L.P.